A Scranton Gillette Publication

OCTOBER 1958

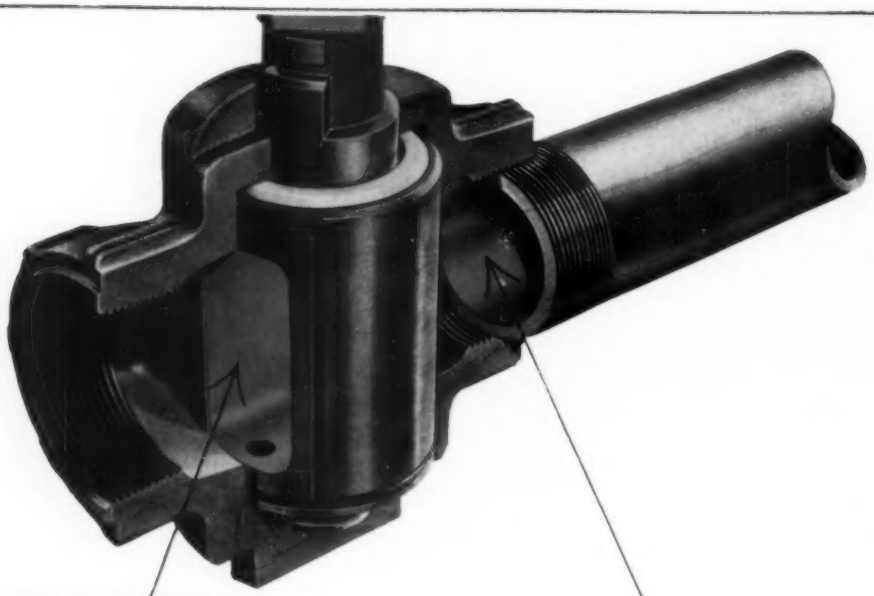
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP.

▲ **DETROIT'S Sewage Treatment Plant is now serving 2,667,000 persons including 34 suburbs and will be expanded in the next two decades to serve 4,000,000—a fine example of area approach to sewage problems and good neighbor policy.**

Chlorination of Water I—p. 411
Synthetic Detergents—p. 425
Sewage Colloids—p. 428
High Rate Treatment—p. 440



This Rectangle Equals This Circle!

acf Lubricated Plug Valves give you minimum turbulence ... minimum pressure drop

The shape and size of the rectangular ports of ACF Lubricated Plug Valves combine flow efficiency of the pipe with compact plug valve design.

The flow of fluid from pipe through plug is unimpeded: entrance chamber design reduces turbulence to a minimum, and loss of head pressure is kept to a minimum.

Other advantages: tight sealing without wedging or sticking; Teflon* head gasket; quick quarter-turn opening and closing; precision lubrication; knife-edge shearing action of the plug.

For efficiency, for easy operation, for low maintenance and long life, specify the industry's finest—ACF Lubricated Plug Valves.

*Du Pont's tetrafluoroethylene resin.

ON HAND

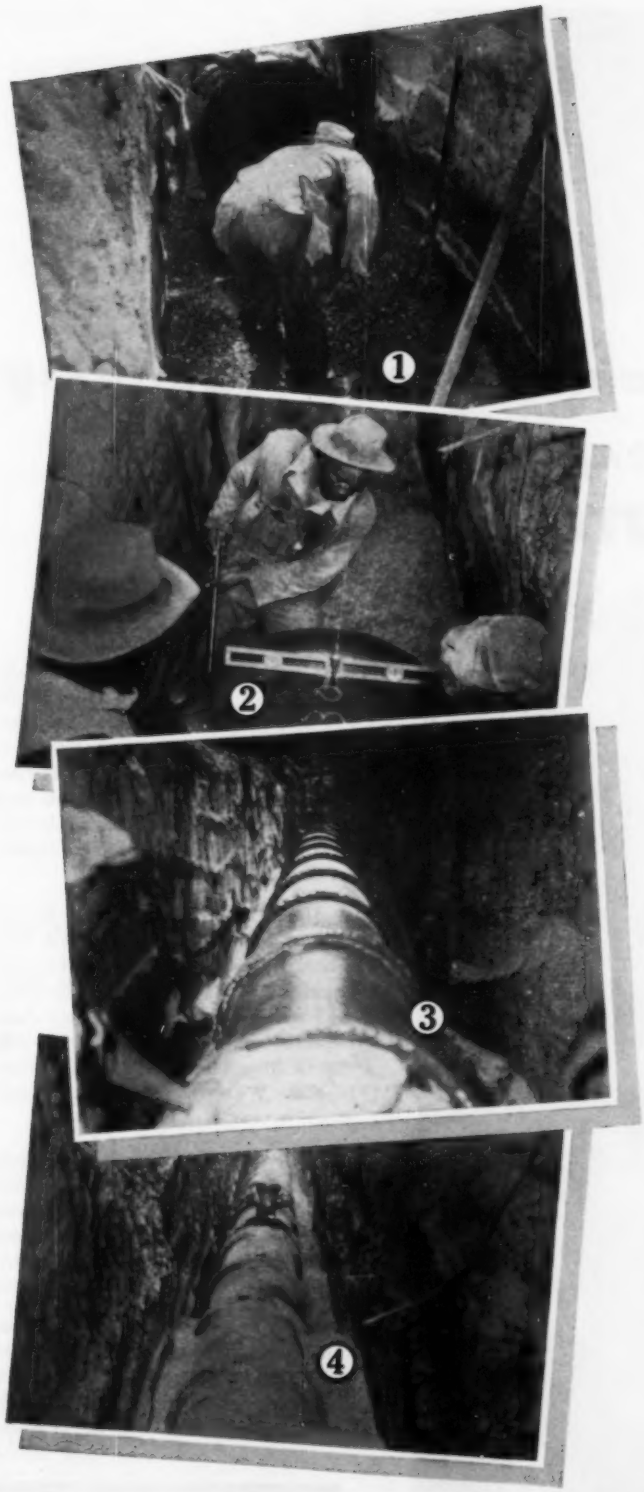
Order ACF valves from your industrial jobber or supply store. Sizes: ½-inch through 30-inch. Pressures: 125 lbs. WOG to 500 lbs. WOG in semi-steel. ASA 150 and ASA 300 in carbon steel. Rectangular, round, V and diamond ports. Bronze and aluminum valves available for use where indicated.

W-K-M

DIVISION OF acf INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

W-K-M's *Creative Engineering* **can assist you with any special problem. If it involves flow of fluids or gases through valves, check first with W-K-M.**

5804



perfect example of expert workmanship

To receive *all* of the benefits offered by Vitrified Clay Pipe, good installation practices are important. This exclusively Clay Pipe installation, at Shreveport, La., is an outstanding example of how expert workmanship helps assure the long-term benefits that only Clay Pipe can offer.

① Proper bedding is one of the most important steps in the installation of Vitrified Clay Pipe. At Shreveport, gravel was used to provide firm bedding for the pipe.

② Each section was tested for true alignment and adjusted for exact grade and position as lengths were jointed.

③ Good jointing helped construct a tight, leak-proof line.

④ A light, rock-free aggregate was distributed in the trench before backfilling to reduce stress directly on the line. Workmen used extreme care in backfilling to make certain the line was not disturbed.

Superintendent of Water and Sewers, Thomas L. Amiss
Asst. Supt. of Water and Sewers, Charles B. Foster
Consulting Engineers, Black & Veatch, Kansas City
General Contractor, John A. Petty, Longview, Texas

C 858 B

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 296 Mark Bldg., Atlanta 3, Georgia

One of two Permutit Automatic Valveless Water Filters at O. M. Scott & Sons Co. Chemical Products Plant, Marysville, Ohio. Each filter is 7' diam. and rated at 116 gpm. The complete Permutit water-treatment system was engineered by H. A. Williams and Associates, Columbus, Ohio.

"No maintenance or operating expense with our PERMUTIT Valveless Filters"

● These filters have been operating continuously for over a year and a half . . . supplying water for process, boiler feed and drinking. They follow a Permutit Precipitator that treats raw well water with lime, soda ash and coagulants. Either filter can handle full feed rate during inspection or repairs on the other.

● Here's how Glenn L. Moll, Scott's Service Manager, puts it: "Our Permutit Automatic Valveless Filters are operating very satisfactorily. The filter-bed and underdrain system stay clean with no evidence of blow holes or sifting of filter media to the underdrain system. We now inspect them only twice a year."

● The Valveless Filter is completely automatic—yet costs up to 45% *less* than conventional automatic gravity filters because it uses no expensive valves, flow controllers, pumps or hydraulic or pneumatic control systems.

Send for descriptive bulletin. Address: The Permutit Company, Dept. WS-10, 50 West 44th Street, New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

PERMUTIT®

rhymes with "compute it"

A DIVISION OF PFAUDLER PERMUTIT INC.

Water Conditioning

Ion Exchange • Industrial Waste Treatment

Vol. 105 No. 10

OCTOBER • 1958

A Scranton Gillette Publication

E. SCRANTON GILLETTE
Publisher

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Frank J. Schwemler, Commissioner of Water
Consulting Engineers—Havens and Emerson
Prestressed Concrete pipe by Price Brothers

Cleveland...

...uses Pratt Valves in a tight spot

City installations, with limited clearances and traffic problems, are never easy. This Cleveland project, tying a new booster station into two distribution lines, is about as tough as they come.

Here the specifications could not call only for "dependable valves" . . . it had to be "*dependable valves that are easy to install.*" This is where the engineer and contractor can tap the benefits of Pratt's long experience . . . major features of Pratt Butterfly Valves include exactly those things that simplify difficult jobs: minimum head room, versatile operators that can be buried without vaults . . . and design and construction such that the valve will always be easy to open or close.

If you would like to know more about Pratt Butterfly Valves, 40 page manual B2B is yours for the asking. *Henry Pratt Co., 2222 S. Halsted St., Chicago 8, Ill.* Representatives in principal cities.

See us in booth 134 at the A.W.W.A. Convention in Dallas, Texas; April 20-25

HENRY PRATT

RUBBER SEAT Butterfly Valves

BRIEFS

Detroit's Sewage Treatment Plant went into operation in 1940 to serve 1,770,000 persons; it now serves a population of 2,667,000 in Detroit and 34 suburbs. This plant will be visited on an inspection tour by the 31st annual FSIWA meeting where the visitors will see the equipment and operation procedures described on page 399.

Building for Tomorrow is the program adopted by Detroit's Board of Water Commissioners to handle that ever growing metropolitan area. A $33,000,000 program for the next 20 years, adopted this past spring, is reported on page 407.

Chlorination of Water is the first of a series of six articles on a Chlorination Guide for water and sewage works operation. This first article is devoted to fundamental concepts of chlorine and its reactions in water and sewage — page 411.

The Thames Conservancy has been functioning for 100 years. It has an interesting history, as do the efforts to abate pollution of The Thames River as long ago as the 11th century — page 418.

Sewer Cleaning and Safety Measures need realistic schedules if sewer capacities are to be maintained — page 420.

Synthetic Detergents are important to the sanitary engineer and the water and sewage works operator because they have affected the character of sewage and the use of water. While their effects on sewage treatment and water treatment are still subject to controversy, it is desirable for engineers and operators to know something about the detergents themselves — page 425.

Sewage Colloids and their dispersion and aggregation are highly significant in sewage treatment. Here is a study of sewage colloid systems— page 428.

Digestor Net Effective Capacity has a specific meaning and is the most important cubage in a sludge digestion tank. Arlington County, Va. is an example of how net effective capacity was maintained at a desirable value — page 435.

High Rate Sewage Treatment means different things to different people. A study of the various processes now in use reveals that there are two basic meanings of the term — page 440.

A Reminder: The 1958 Annual Reference Number which was mailed recently to all subscribers carries a consolidated five-year index to subject matter and authors (1958 and four previous issues). This five-year index is included because many of the reference articles of the previous four years have not become out of date. Therefore, for a complete reference library subscribers should keep the current issue and past four issues.

Today's Modern Water Tanks Prestressed Concrete Type

Long and Short Term Economies Making Them Popular

A modern prestressed concrete tank is not only economical in first cost, but because of its almost maintenance free character, offers any municipality real long term economy. Any tankage engineering study should include calculated maintenance costs over the estimated life of the facility. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and

their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

The prestressed concrete tank is also a good looking tank . . . it is inherently strong and extremely stable . . . it is designed and built for permanence. And, 75% of the contract price is spent right in your local community . . . construction is done with materials and labor available locally.

Write today for more information on Preload Prestressed Concrete Tanks.

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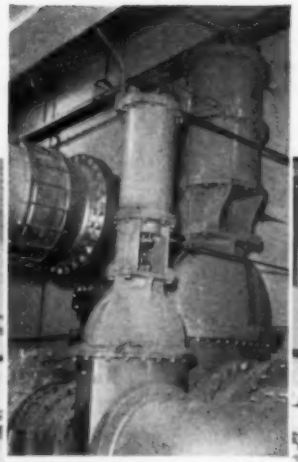
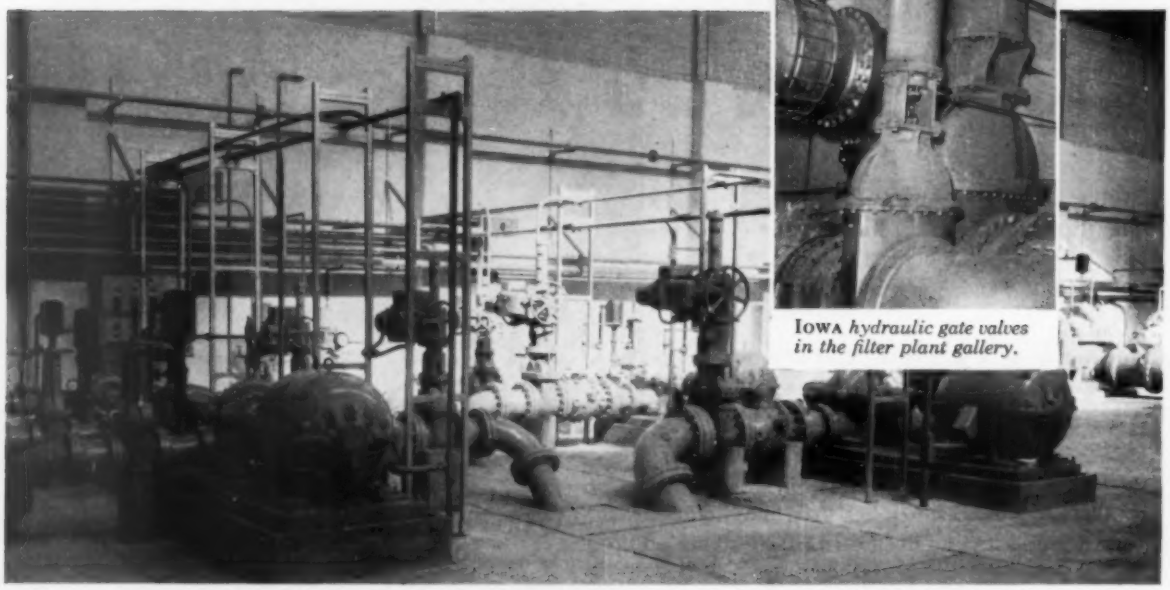
40 IOWA GATE VALVES...



IOWA *hydraulic gate valves in the filter plant gallery.*



IOWA *motor-operated gate valves installed in the main pump station of North Texas Municipal Water District. (General Manager: Mr. A. P. Rollins; Consulting Engineers: Forrest and Cotton; Design Engineer: Mr. Ormond A. Stone.)*

Control delivery of
20 million gallons of water a day
for the North Texas Municipal Water District

• Forty IOWA Hydraulic and Motor-operated Gate Valves—from 4" to 30" sizes—are used in the Filter Gallery and High Lift Pump Station of the North Texas Municipal Water District, supplying 10 North Texas Municipalities and the District's largest customer, the City of Dallas. Additional IOWA gate valves are used in the six pumping plants operated by the district.

The Filter Plant, located at Wylie, Texas, has a capacity of 20 million gallons a day. However, the design is such that it can operate safely at twice this amount. Water is delivered to the ten member municipalities and the City of Dallas through 90 miles of transmission line, ranging from 12 to 42 inches in diameter.

This Texas application is typical of the ability of IOWA to furnish gate valves to meet the most exacting specifications for plant and distribution service. Be sure and check the wide variety of IOWA valves, accessories and specialties before you place your order.

Let us send you details on Iowa's complete line of valves and hydrants

IOWA
VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.
Oskaloosa, Iowa

News—Here & There

Lee T. Purcell

Consulting Engineer of Paterson, N. J., has been appointed as a member of the Board of Professional Engineers and Land Surveyors of the State of New Jersey. The appointment was made by Governor Meyner pursuant to the recommendations of the State Society of Professional Engineers.

A native of Troy, N. Y., and a graduate of Rensselaer Polytechnic Institute, he founded his firm of consulting engineers in 1940. He was formerly an engineer-chemist with the North Jersey District Water Supply Commission at Wanaque, N. J., which agency he still serves in the capacity of Consulting Engineer. Mr. Lee is a member of ASCE, APHA, APWA, AWWA, FSIWA and NSPE.

Three Water Works Controllers

have been elected directors of their respective chapters of the Controllers Institute of America. The Institute was formed in 1931 and has 4,800 members.

Elected as directors of the Puerto Control are: M. Joseph Borst, Comptroller, Chief Finance Division, Puerto Rice Aqueduct & Sewer Authority, and Antonio E. Labron, Controller, Puerto Rico Water Resources Authority.

Another new director, this one of the Institute's Indianapolis Control is Ralph L. Swingley, Secretary-Treasurer, Indianapolis Water Co.

Earnest Boyce

Chairman of the Civil Engineering Department at the University of Michigan and professor of public health engineering, has returned to the University from a sabbatical leave spent as a sanitary engineer consultant for the World Health Organization (WHO).

During May he served as technical director of an environmental sanitation seminar at Port Moresby, New Guinea. Prior to this assignment, he was sent by WHO to several South Pacific Islands to learn first hand of the public health problems of the area. He began his WHO work in Manila on Feb. 10.

Vermont

has received a unique mobile laboratory which will enable the State Water Conservation Board to conduct field studies of the State's water resources. The vehicle shown here was purchased with Federal aid funds made available to the Board for the expansion of its pollution abatement program. The truck is a completely equipped laboratory which can operate even in remote areas where there is no power or heating facilities.

Shown with the new mobile laboratory are: Robert Carr, Adm. Asst., William Albert, Director, Water Pollution Control, Fred. Fuller, Jr., Lab. Asst.; and Fred Fuller, Sr., Chief, Laboratory Division.

F. W. Montanari

Staff Sanitary Engineer of Orsanco has been elected Secretary-general of the Inter-American Association of Sanitary Engineering (AIDIS). Mr. Montanari has long been identified with sanitary engineering developments in Latin America. Before joining Orsanco he spent eleven years with the Institute of Inter-American Affairs as consultant on programs in Brazil, Mexico, and Panama.

Peter S. Marra

in charge of the Mineola, L. I. office of Nussbaumer, Clarke & Velzy, has been named an associate of the firm. In eight years that Mr. Marra has been with the firm, it has designed more than $50 million worth of sanitary sewer projects in Nassa County.

Mr. Marra is a graduate civil engineer from Cooper Union and has a Master of Civil Engineering degree from New York University.

Max Suter

retired on Sept. 1 as principal engineer for the Illinois State Water Survey. Dr. Suter has been associated with the State Water Survey since 1936 and from 1940 until last year he was head of the Survey's Peoria, Ill. laboratory, where his research developed new theories with regard to replenishing ground water aquifers. Since 1957 he has been making comprehensive studies of ground water conditions in the Chicago region.

Dr. Suter received his civil engineering degree from the Federal Institute of Technology of Zurich, Switzerland, and he received both his Masters Degree and Doctrine in sanitary and hydraulic engineering from the University of Illinois.

He is a member of AAS, ASCE, AWWA, AGU, FSIWA, IAHR, SAB, NSPE and the Illinois Academy of Science.

Grover L. Waters

Director of Public Works for the City of Fullerton, Calif., since 1955, has retired after 37 years of service to his community. A registered civil engineer, he has been active in water and sewage works endeavors since 1929. He is President of the Orange County Water Works Assn., and is on the Executive Board of the Joint Outfall Sewer in Orange County.

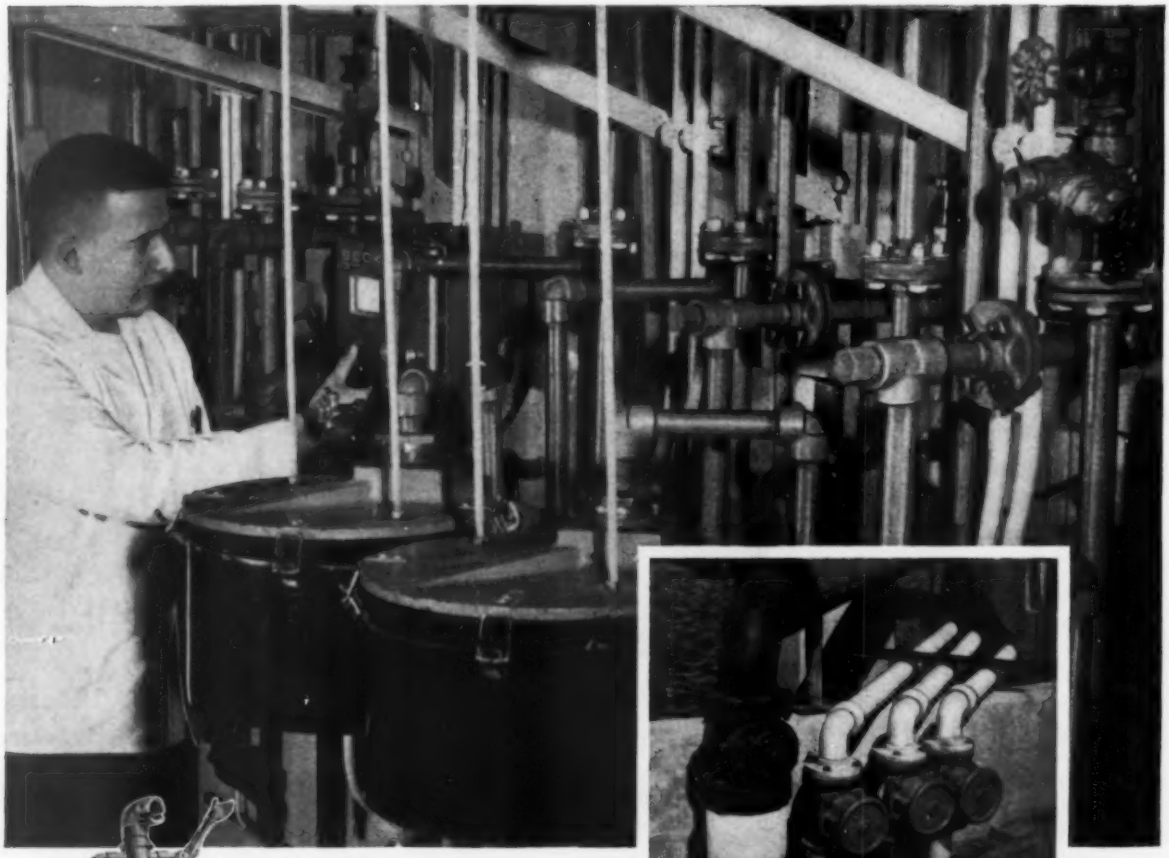
Prior to assuming the position of Director of Public Works, he served as Superintendent of the Building Department and as Superintendent of Water and Sewers. He has actively promoted the Metropolitan Water District of Southern California and will continue to be active in the Feather River Project Assn.

Jamaica, L. I., N. Y.

soon will have the largest water reservoir on Long Island. The Jamaica Water Supply Co., now has under construction a 4,000,000 gal steel tank to provide increased supply facilities for a 3½ mile surrounding area where new housing is planned. The tank will be 230 ft in diameter and 14 ft deep but only 3½ ft of the tank will be exposed above ground.

CONTINUED ON PAGE 15A

USCOLITE PLASTIC PIPE



Mr. Usco reports:

After 5 years, all 8 miles of Uscolite still perform perfectly

The Omaha, Neb., Waterworks formerly used metal pipe to introduce strong chemicals into the water to purify it. But the corrosive fluids ate the metal pipe, requiring pipe replacement about twice a month. Then, "U. S." plastic engineers suggested sampling a piece of ½" Uscolite® plastic pipe.

"We were so pleased and amazed at Uscolite's performance," said a Waterworks executive, "that we quickly ordered it in various sizes for a total length of 43,000 feet. That was over 5 years ago, and today, the Uscolite pipe shows *absolutely no sign of deterioration*. The savings in money and maintenance are tremendous."

Uscolite is deliberately engineered to handle highly corrosive fluids. It is extremely light in weight, yet has high impact strength. It imparts neither taste, odor, nor discoloration. The Uscolite line of pipe, valves and fittings is the most comprehensive plastic pipe line in America and has been awarded the National Sanitation Foundation Seal of Approval.

• • •

When you think of plastic, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality plastic pipe and fittings.

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

NOW ...a NEW MUELLER®

DOUBLE PRESSURE CHAMBER TAPPING MACHINE...

the B-100

MAKES FASTER TAPS!

ASSURES PRESSURE TIGHT CONNECTIONS!

PROVIDES EASY, TROUBLE-FREE OPERATION!

use it by hand or with power...

FORM NO. W-8912

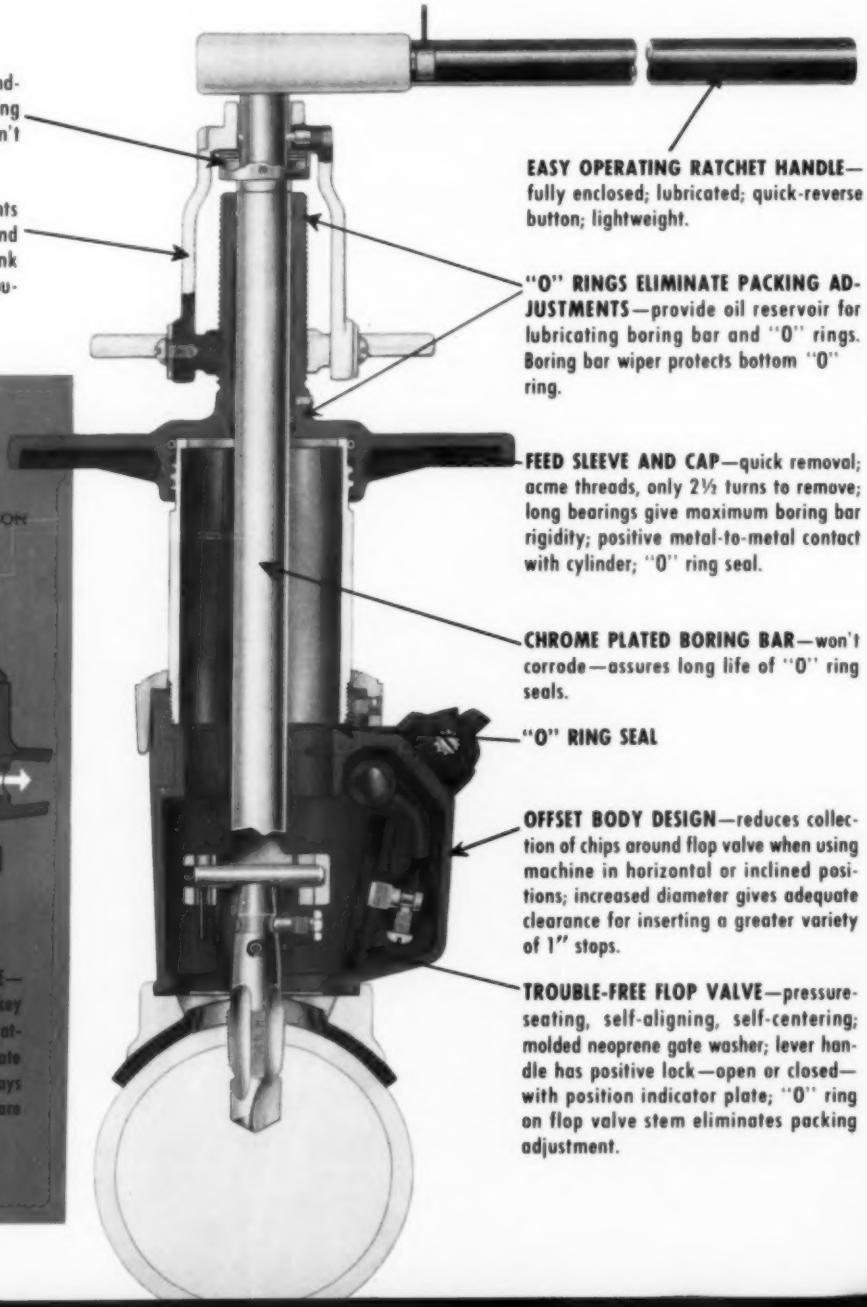
PRINTED IN U.S.A.

Features and Benefits

Fast taps, pressure tight connections and easy trouble-free operation provide an operating efficiency so necessary to meet today's demands. The new B-100 Drilling, Tapping and Inserting Machine gives these results IMMEDIATELY and CONSISTENTLY.

The machine incorporates the same basic double pressure chamber, single boring bar design principle which, through 86 years of field experience, research and testing, has proved to be the most efficient in operation. Its design permits the operator to handle the machine in lightweight sections. The tapping and inserting operations are performed separately. Tool or stop may be safely removed from the machine at any time during the operation for inspection or replacement, if necessary.

The "B-100" is *all new* from the saddle up, and has plus features we know you have wanted. Look over these features—see how they all combine to contribute to faster taps, pressure tight connections and easy, trouble-free operations.



ANTI-FRICTION THRUST COLLAR—sandwich type nylon-teflon-nylon bearing sealed in steel case; no lubrication; won't gall under power operation.

FEED NUT AND YOKE—spring detents hold feed yoke securely in place around boring bar; acme threads; square shank on feed yoke fits power operator for automatic feed.

EASY OPERATING RATCHET HANDLE—fully enclosed; lubricated; quick-reverse button; lightweight.

"O" RINGS ELIMINATE PACKING ADJUSTMENTS—provide oil reservoir for lubricating boring bar and "O" rings. Boring bar wiper protects bottom "O" ring.

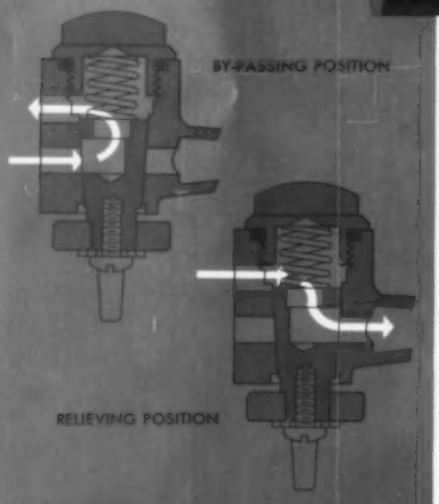
FEED SLEEVE AND CAP—quick removal; acme threads, only 2½ turns to remove; long bearings give maximum boring bar rigidity; positive metal-to-metal contact with cylinder; "O" ring seal.

CHROME PLATED BORING BAR—won't corrode—assures long life of "O" ring seals.

"O" RING SEAL

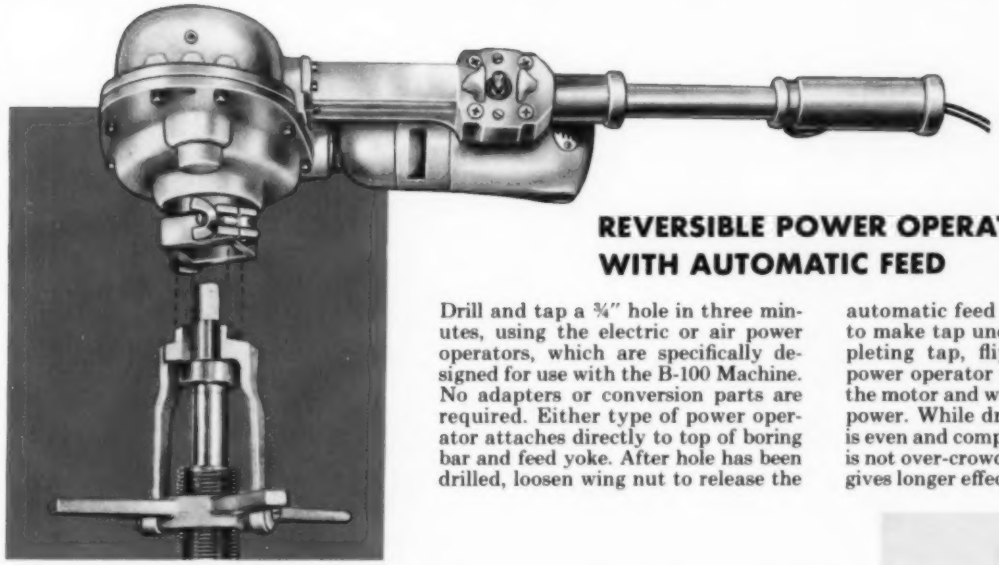
OFFSET BODY DESIGN—reduces collection of chips around flop valve when using machine in horizontal or inclined positions; increased diameter gives adequate clearance for inserting a greater variety of 1" stops.

TROUBLE-FREE FLOP VALVE—pressure-seating, self-aligning, self-centering; molded neoprene gate washer; lever handle has positive lock—open or closed—with position indicator plate; "O" ring on flop valve stem eliminates packing adjustment.



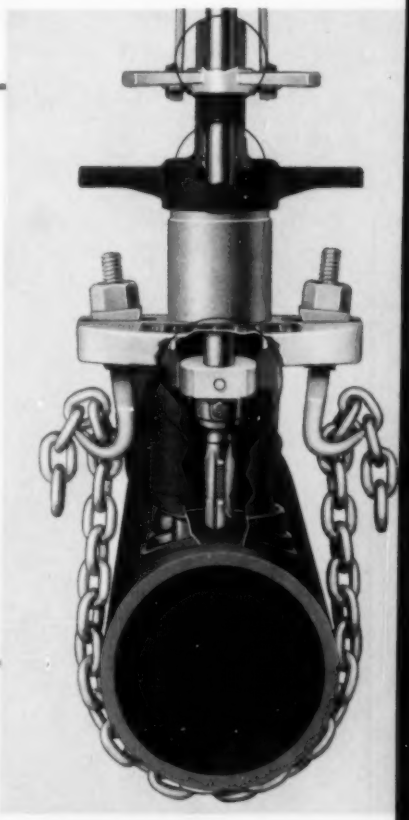
EASILY MAINTAINED BY-PASS VALVE—self-contained, spring-loaded, ground key valve with fluid escape deflector; easily attached; wing-type handle with indicator plate clearly shows position. Straight passageways through ground key valve and body are easily cleaned.

owners and operators will like...



REVERSIBLE POWER OPERATOR WITH AUTOMATIC FEED

Drill and tap a ¾" hole in three minutes, using the electric or air power operators, which are specifically designed for use with the B-100 Machine. No adapters or conversion parts are required. Either type of power operator attaches directly to top of boring bar and feed yoke. After hole has been drilled, loosen wing nut to release the automatic feed driver, then continue to make tap under power. After completing tap, flip the switch on the power operator to reverse direction of the motor and withdraw the tool under power. While drilling, boring bar feed is even and completely automatic—tool is not over-crowded; does not overheat; gives longer effective tool life.



ASSURED RIGIDITY

ON THE MAIN

Pressure-tight connections start with complete machine rigidity on the main. Aluminum alloy chain yoke has high strength—lightweight. Chain hook washers are widely spread and deeply recessed in yoke to prevent slipping off on large diameter pipe. Chain hook cannot rotate—chain cannot twist during tightening. Square shank on chain hook fits inside square hole in chain washer. Square shank on chain washer prevents turning in yoke. Acme threads on chain hooks give long life. Chain hooks, chain hook washers and chain hook nuts are cadmium plated to resist corrosion.

IN THE BORING BAR

Perfect alignment of the boring bar is assured by three boring bar bearings; two, widely spaced in the feed sleeve, and the third at the extreme bottom end of the boring bar. The lower bearing is of molded nylon and closely bears against a machined surface in the body when the drill first contacts the main and also when the stop is being inserted. Curvature of the pipe cannot deflect the drill—tools are relieved of unnecessary stresses and give longer effective life. These three widely spaced boring bar bearings assure perfect centering of tool and stop for accurate threading and a pressure-tight connection.

NEW TOOL RETAINER WITH INDEPENDENT DRIVE

Drive pins in shank of new combined drill and tap or E-Z Release Screw Plug slip into notches in the boring bar socket. All driving force is exerted against these drive pins, preventing damage to the surface of the tool shank. Tool retaining screw in replaceable bronze sleeve bears against the upper part of a circular groove around tool shank—holds tool tight in boring bar socket. This new holding and driving arrangement assures perfect tool-boring bar alignment and maximum rigidity, for long tool life.

No problem to remove tools in the "B-100". Just loosen the tool retaining screw, tap the knockout pin in the tool holder and the tool slides out in your hand.

MUELLER®

B-100 DRILLING, TAPPING AND INSERTING MACHINE

CAPACITY AND USE

The B-100 Machine will drill and tap the main and insert the following items under pressure: corporation stops and gas main stops ½" through 1"; machine inserted valve tees ¾" and ¾"x1"; and pipe plugs ½" through 2½".

Combined drills and taps and screw plugs are not interchangeable between the B and B-100 Machine. Saddles are interchangeable with the B Machine.

WORKING PRESSURE

90 p.s.i. without power clevis.
250 p.s.i. with power clevis.

B-100 MACHINE AND EQUIPMENT FURNISHED

Ratchet handle
Small saddle gasket
Large saddle gasket
Chain hooks and nuts
Chain washers
Round link chain
Chain hook nut and tool retaining screw wrench
Body cleaning chisel
Lubricating oil
Cutting grease

Shipped in strong wooden chest. Total shipping weight 97 pounds.

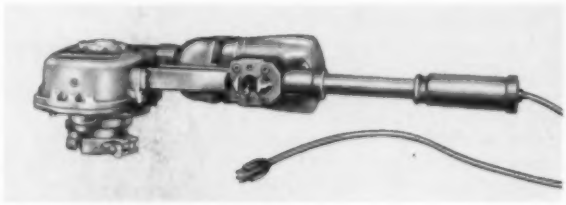
Handling weight during operation: upper section 19 pounds; lower section 23 pounds.

EQUIPMENT TO BE SELECTED

Combined drills and taps
Saddles
Screw plugs
Extracting tools

OPTIONAL POWER OPERATORS

Electric or air power operators are offered as optional equipment for use with the B-100 Drilling and Tapping Machine. Either unit is suitable for 1" taps through any kind of pipe. Drive spindle turns at 35 r.p.m.—motors are reversible.



H-603 ELECTRIC POWER OPERATOR
110-120 volt A.C. or D.C.

H-604 AIR POWER OPERATOR
90 p.s.i. pressure (full load)

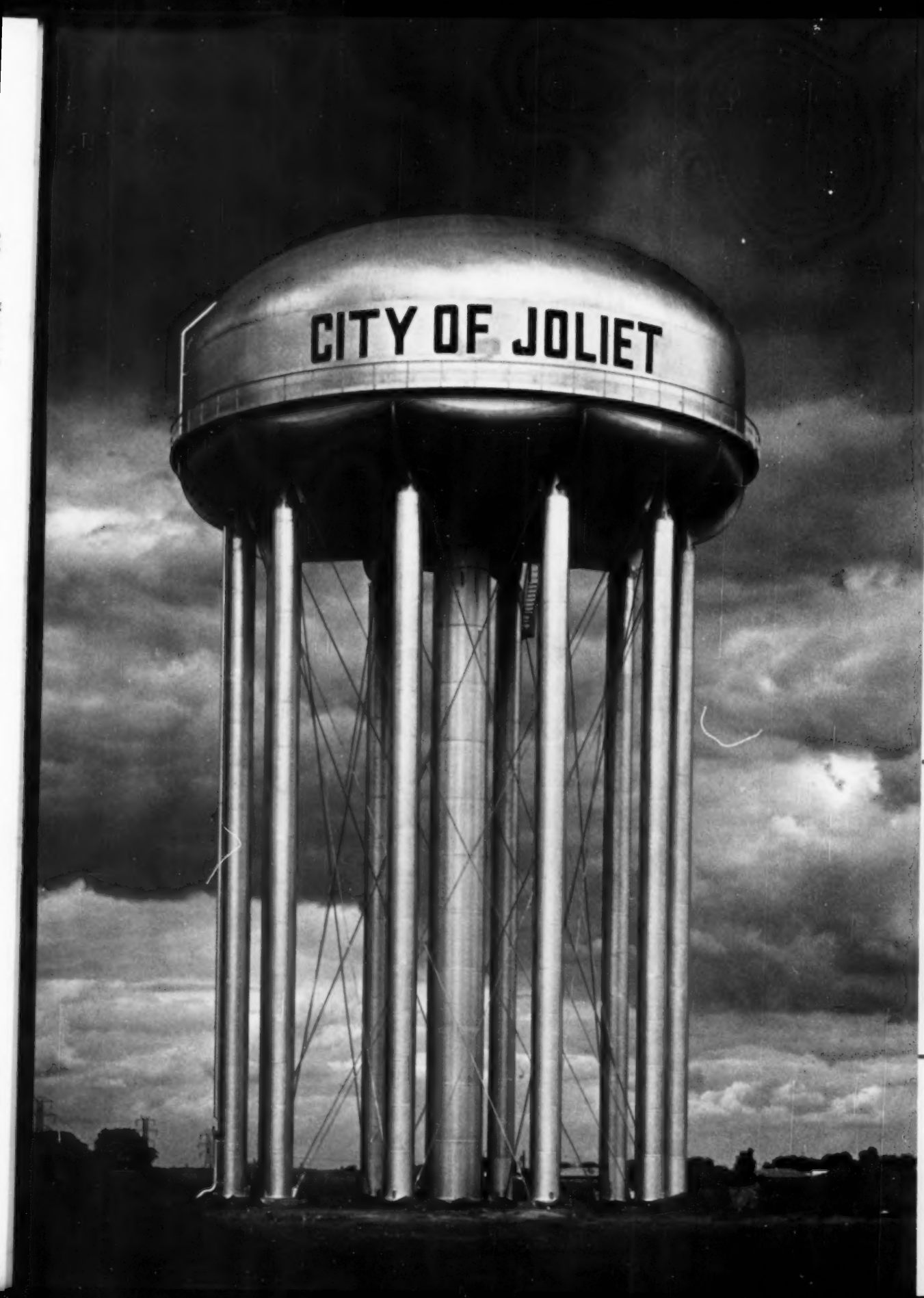
OPTIONAL EQUIPMENT FOR SPECIAL USES

Power clevis
Chain spreader
Corporation stop wrench
Round link extension chains
Long Ratchet Handle Bar (used for drilling and tapping operations on cuts over 1" in size).

Since 1857 SERVING the Water and Gas Industries

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario



FILE REFERENCE

FACT SHEET

GRAVER®

Million Gallon Tank One of Two for Joliet, Ill. System

James P. Hennessy, Mayor
Chester B. Lewis, City Manager
Consoer, Townsend and Associates
Consulting Engineers, Chicago, Ill.
Graver Tank & Mfg. Co., Inc.
Fabrication and Erection

Type: Radial-Cone Bottom Elevated Tank
Capacity: 1,000,000 gallons
Height to Overflow: 125'
Head Range: 30'
Diameter of Tank: 78'
Built to A.W.W.A. and Consultants' Specifications
Painted. Sterilized and Cathodic Protected

THE PROBLEM

A 20% gain in population to 70,000 in 5 years, with a 40% additional increase anticipated by 1975, placed some urgency on the completion of the storage and distribution phase of a long-range water service expansion program started in 1947 in Joliet, Ill. New wells, reservoirs, pumping stations, sewer and water extensions into surrounding unincorporated areas, as well as a sewage treatment plant and intercepting sewers had been completed. Still to be accomplished was the replacement of an old, badly-corroded 200,000 gallon elevated tank. With some 90% of the city's growth taking place on the West Side, the final steps had to be taken to distribute water throughout the new system under adequate pressure.

THE SOLUTION

The solution was a new 1,000,000 gallon radial-cone bottom elevated tank riding on the West Side high service system and a new 250,000 gallon double-ellipsoidal elevated tank riding on the new open system in the East Side high service area. Graver was selected to fabricate and erect both tanks, and to paint, sterilize and provide cathodic protection for each.

The million gallon tank on the West Side, featured at the left and on the next page, will provide ample water at 53 pounds pressure for the fire protection and domestic requirements of about 60% of the present population and some 4,000 people in adjacent areas. Telemetry controls the water level in the large tank—as the water level recedes, the pumps automatically refill the tank from an underground reservoir. Should the power fail at the pumping stations, the elevated storage assures uninterrupted water service.

The fabrication and erection of these two tanks for the City of Joliet, Ill. demonstrates Graver's capacity to handle every detail of fabrication and erection of elevated water tanks of all sizes and types.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
New York • Philadelphia • Edge Moor, Delaware
Pittsburgh • Atlanta • Detroit • Chicago • Tulsa
Sand Springs, Oklahoma • Houston • New Orleans
Los Angeles • Fontana, California • San Francisco

BUILDING FOR THE FUTURE ON A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

DESIGNED, FABRICATED AND ERECTED BY GRAVER®

GRAVER TANK & MFG. CO., INC. EAST CHICAGO, INDIANA

New York • Philadelphia • Atlanta • Edge Moor, Delaware • Pittsburgh • Detroit • Chicago • Tulsa
Sand Springs, Oklahoma • Houston • New Orleans • Los Angeles • Fontana, California • San Francisco

News—Here & There

CONTINUED FROM PAGE 7A

Dr. Paul Fromm

of the Department of Physiology and Pharmacology of Michigan State University in Lansing, Mich., was recently elected president of the Midwest Benthological Society, and organization of biologists interested in studying and exhibiting information about all forms of water life.

Dr. Fromm called for more emphasis on biological rather than chemical tests for pollution of rivers and lakes. He said the Midwest Benthological Society is a clearing house for this sort of information on how pollutants both biological and chemical affect fish and plants.

George H. Jewell

died in mid-July at the age of 76. A longtime member of the American Water Works Assn., he had been a Sales Representative for B-I-F Industries, Inc. for 40 years in the Chicago area and he was well known, well liked, and active in water works affairs until his death.

The Penna. Sanitary Water Board

held its 400th meeting in mid-July. The Board, established in 1923, held its first meeting on July 17 of that year and since 1947 has met almost every month to administer the States clean streams laws.

The States original "purity of waters" law of 1905 was supplemented in 1937 and 1945 by much more comprehensive anti-pollution laws, giving the Board broad powers to control sewage, industrial wastes, and mine drainage. Since passage of these later laws, the State of Pennsylvania has been credited with doing more than any other state in controlling pollution along its more than 4,400 named streams.

The State Health Department's Division of Sanitary Engineering acts as the Board's investigating and recommending agent.

Fifteen Years Ago

this month, the Federation met in Chicago and Ed Cleary, then of ENR, now of Orsanco spoke on the sanitary engineering conditions in South America—"Blue Print Now!" was the slogan of the day instead of "Do It Now!"—The Office of Price Administration set a ceiling price on sewage sludge for the cities of Chicago, Houston, and Milwaukee—And, in those presyndet days, the Ohio Sewage Treatment Conference heard definitions of "suds" as opposed to "foam" in activated sludge plants. Neither definition characterized the conditions that have been reported in recent years.

The Illinois State Chamber of Commerce

held its second state-wide water supply conference in Chicago on Aug. 27. Special emphasis was given to Illinois Water Pollution Problems. Speakers included Maj. Gen. E. C. Itschner, Chief of U. S. Army Engineers; Milton P. Adams, Director, Mich. State Water Resources Comm.; Morris Cohn, Editor, *Wastes Engineering;* B. A. Poole, Tech. Secy. Indiana Stream Pollution Control Board, C. W. Klassen, Chief San. Engr., Ill. State Dept. of Health; C. S. Boruff, Tech. Director, Hiram Walker & Sons, Inc.; Hudson Biery, Exec. V. P., Ohio Valley Improvement Assn.; L. S. Hartley, Manager, Agr. Dev. Div., B&O Railroad; C. M. Hoff, Exec. V. P., Brandywine Valley Assn., Wilmington Del. Harry E. Schelnz, Pres., Pacific Flush Tank Co., presided at the luncheon session and J. W. Nixon, V. P. & Gen. Mg. of National Petro-Chemicals Corp., Tuscola, was General Chairman of the meeting.

James B. Corey

has been appointed to the position of Director of Water Works Advancement for the Amer. Water Works Assn. This is the position created by the Board last spring; it will involve spreading the message of "improved water service" through participation in section meetings and cooperation with local "hoot and holler" committees. As outlined by the advancement committee, Mr. Corey's primary goal in the first phase of the program will be to facilitate the improvement of water works management through the establishment of seminars, short courses, and other training aids for managerial personnel. He will also aid in the development of water works speakers bureaus and in the preparation of new materials for the public information aspects of the program.

Mr. Corey brings to this task a background of business experience, real estate, insurance and two years of fund raising public relations and program direction as Northeastern Regional Director of the National Multiple Sclerosis Society.

WSWMA Exhibitors

at the Federation meeting in Detroit this month include:

Airkem, Inc.
American City Magazine
Armco Drainage & Metal Prod., Inc.

B-I-F Industries, Inc.
Burgess-Manning, Penn Instr. Div.

Chain Belt Co.
Chicago Pump Co.
Combustion Engineering, Inc.

DeZurik Corp.
Dorr-Oliver, Inc.

Eimco Corp.
Engineering News Record

Fischer & Porter Co.
Foxboro Co.

Hardinge Corp., Inc.
Homestead Valve & Mfg. Co.

Inertol Co., Inc.

Jeffry Mfg. Co.
Johns-Manville Sales Corp.

Keasbey & Mattison Co.
Komline-Sanderson Eng. Corp.

Lakeside Engineering Corp.
Ling-Belt Co.
Lock Joint Pipe Co.

Nichols Eng. Res. Corp.

Pacific Flush Tank Co.
Price Bros. Co.
Public Works Magazine

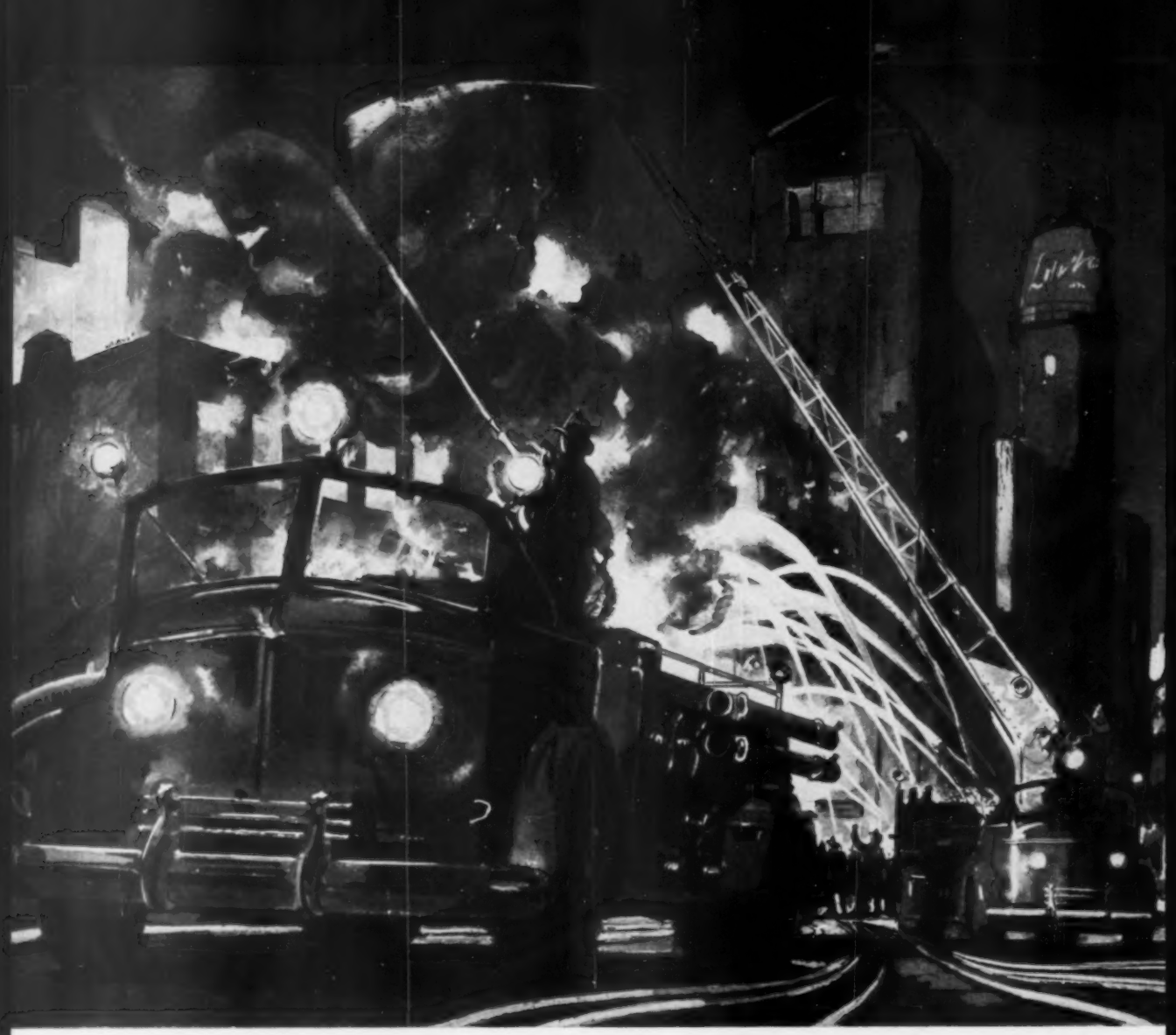
Ralph B. Carter Co.
Robinson Clay Prod. Co.
Roots-Connersville Blower Co.

Simplex Valve & Meter Co.
Smith & Loveless, Inc.
Smith-Blair, Inc.
Stuart Corp.

Vapor Recovery Systems

Walker Process Equip. Co.
Wallace & Tiernan Co.
Wastes Engineering
Water & Sewage Works
Western Machinery Co.
Worthington Corp.

Yeomans Bros. Co.



Behind the fire fighters...water wells by Layne

Municipal water requirements are as varied as they are vital. The reliability of a water source is foremost when human lives and happiness are at stake.

For over 75 years, Layne & Bowler, Inc. and its associate companies have pioneered and specialized in the development of ground water. Their only concern—their only business is water.

Layne water wells and pumps circle the globe. Various conditions and problems have been met and solved. This know-how, acquired during three quarters of a century of experience, results in efficient, economical wells—the basis of most municipal water systems. Layne wells provide the good beginning.

LAYNE & BOWLER, INC. MEMPHIS

General Offices and Factory — Memphis 8, Tenn.
Layne Associate Companies Throughout The World

Water Wells • Vertical Turbine Pumps • Water Treatment

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MEMPHIS 8, TENN.

Gentlemen: Please send me bulletin No. 27.

*Name*_____

*Title*_____

*Organization*_____

_____

*Address*_____

*City*_____

*State*_____

Equipment News

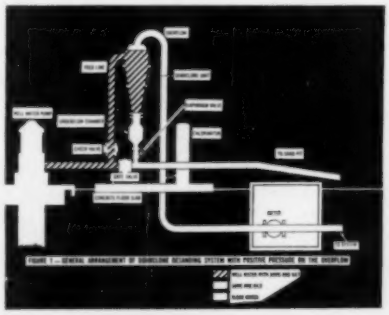
Desanding System

1001

Dorr-Oliver, Inc., Stamford, Conn., has developed the DorrClone Desanding System for the removal of sand from water supplies.

This new system provides an inexpensive method of continuously eliminating highly abrasive fine sand and silt from distribution mains and their components. A variation of the DorrClone classifier widely used in the chemical and metallurgical industries, the desanding system is presently used by a number of municipalities to desand well water.

The complete system comprises a DorrClone classifier with attached underflow chamber and attendant piping and supports. The DorrClone unit, in which sand removal is affected, is a wet cyclone, rubber lined and cylindro-conical in shape. In all units the rubber lining is replacable and depending upon cyclone size, the liner may be either molded exactly to the shape of the body or vulcanized in place. Choice of the size of the cyclone, available in diameters of 6, 12 or 24 inches, depends primarily upon capacity requirements and flow variations.



In operation, sand bearing raw water enters the cyclone tangentially and is subjected to centrifugal forces within the unit. These forces throw sand particles outwardly to the walls which serve to guide sand down the cone and into the underflow or collection chamber. This is drained periodically, either automatically or manually. Desanded water, in the meantime, overflows the top of the cyclone.

Most common type of installation involves discharge of treated water from the cyclone directly into the mains at line pressure. With this arrangement the cyclone is mounted vertically and an underflow chamber is provided. This chamber minimizes loss of water with discarded sand. If desired, it is also possible to operate the system with atmospheric rather than line pressure on the overflow.

Major advantage of the DorrClone Desanding System is removal of plus 200 mesh sands, those that have been found to do the most damage in distribution systems. The complete system is extremly conomical both intially and from an operating standpoint. In actual practice, sand as fine as 500 mesh (30 microns) has been eliminated from feed water.

Low Cost Indicating Controller

1002

U. S. Gauge Division of American Machine & Metals, Inc., Philadelphia,

CONTINUED ON PAGE 19A

NOW
LOW-COST AUTOMATIC FLOW RECORDING

Directly Readable Flow Charts

Obtain graphic records of liquid flow directly readable in million gallons per day or gallons per minute over various sizes of Parshall flumes. The same recorder can also be used with charts reading in feet and hundredths to record head or surface fluctuations in lakes, streams, wells. Write for free Bulletin 24.

STEVENS
TYPE F RECORDER

...For Measuring Sewage, Industrial Waste and Other Flows

The planning and efficient operation of any project which involves measurements of flowing liquids is based on flow data which can be obtained with STEVENS Recorders. These instruments are at work compiling data on hydroelectric and flood control projects and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

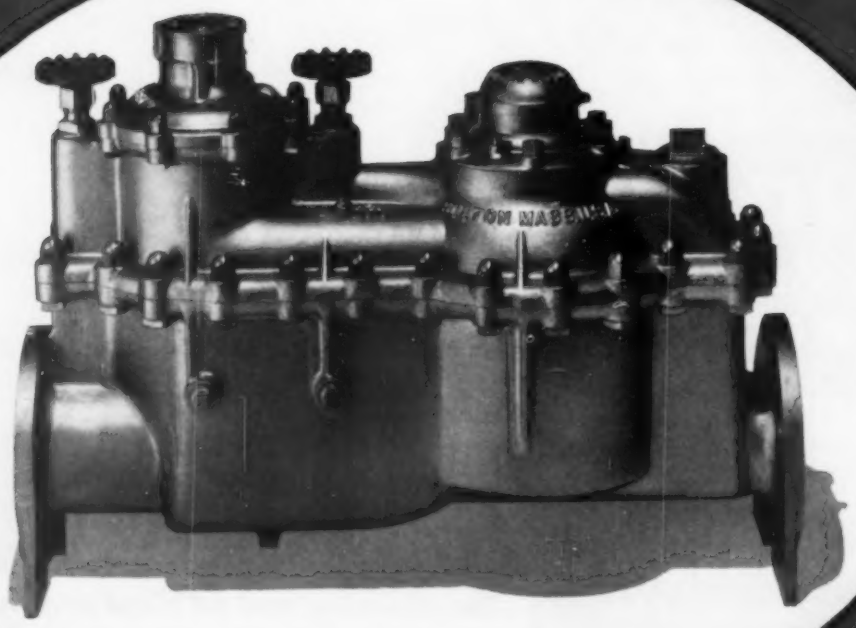
Experienced technical staff available to supply product information for liquid measurement installations. Write, giving description of project and scope of data desired.

HYDROGRAPHIC DATA BOOK
Invaluable for your reference file
124 pages of technical data on recorder installations, plus a wealth of hydraulic tables and conversion tables. $1 copy. (No. COD's.)

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. E. GLISAN STREET • PORTLAND 13, OREGON
specialists in hydrologic instruments for over half a century

HERSEY
COMPOUND METERS

Your best buy for accurate registration at all rates of flow



ALL BRONZE CASE 2" TO 6" INCLUSIVE

HERSEY MANUFACTURING COMPANY

(Est. 1859)

DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

Equipment News

CONTINUED FROM PAGE 17A

Pa., has announced that a new indicating controller, called the USG "Pilot," is now in production.

The unit is specifically designed to meet industry's needs for a compact, low-cost pneumatic controller. Yet, it can provide not only two-position control but also wide band proportional with or without automatic reset or rate action—refinements generally associated with higher-priced controllers.

Measuring 8½ inches square by 4 inches deep, the USG controller can be surface-mounted on equipment, or flush-mounted on instrument panelboards. It can also be mounted directly on the pneumatic-operated valve that it positions.

Indication of measured variable (such as pressure) is made on a 3½ inch precision gauge dial (6¾-inch scale length). A red circle-tipped pointer also indicates the knob-adjusted set point on this same dial.

Plastic Acid Storage Tank Eliminates Maintenance

1003

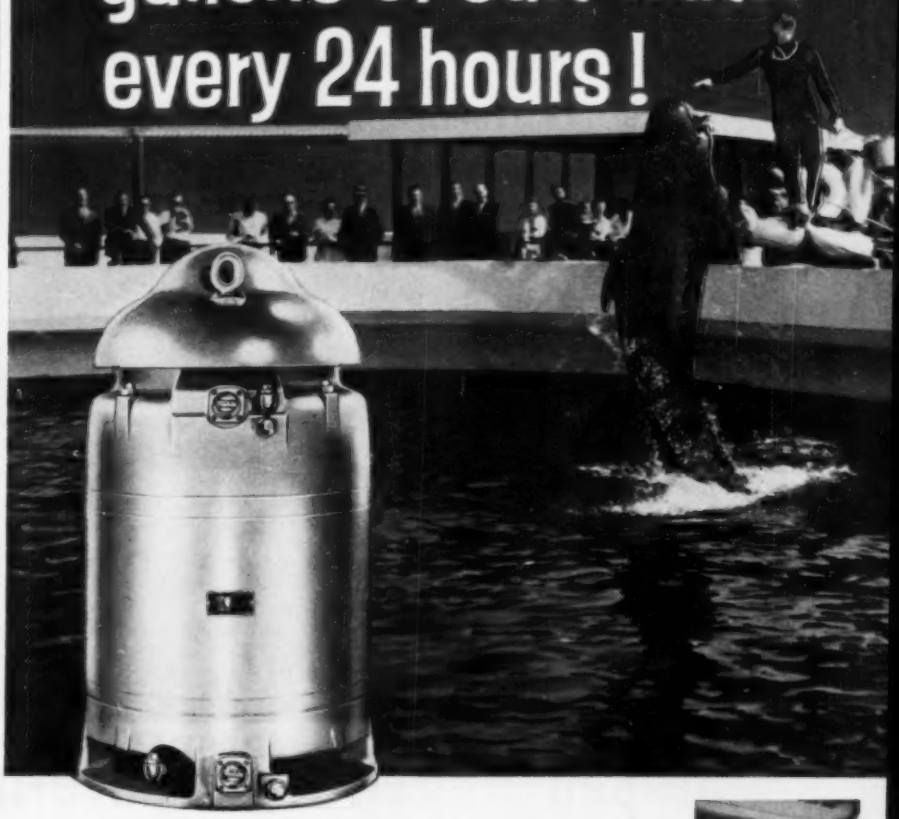
The Ceilcote Co., Cleveland, O., has announced that one of the world's largest acid storage tanks ever fabricated from reinforced plastic has been designed and manufactured from cor-

rosion-proof Duracor. The Duracor tank will hold more than 14,000 gallons of highly corrosive hydrochloric acid. Corrosion-proof throughout, this Duracor tank will last almost indefi-

CONTINUED ON PAGE 21A

the heart of Marineland

pumps over 2 million gallons of salt water every 24 hours!



the lives of "Bubbles" the whale and over 5,000 irreplaceable marine specimens depend on the continuous functioning of

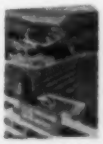
U. S. Verticlosed PUMP MOTORS

For years—functioning continuously under corrosive salt-air conditions in California's world-famous Marineland—U.S. VERTICLOSED MOTORS have given unfailing performance. Such dependability is built in through U.S. engineered design features: Positive lubrication *visually* verified; king-size thrust bearings, bathed constantly by cool air; precision balancing, not only of all rotating components but of the assembled motor as well; all windings *asbestos*-protected for longer life; rugged corrosion-resistant cast-iron case normalized to prevent warp. Available in RATINGS 1½ to 500 H.P. In any turbine pump installation, specify: "U.S. VERTICLOSED MOTORS."

U.S. ELECTRICAL MOTORS INC.

BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

SEND FOR FREE COLOR BROCHURE ... No. F-1903, on U.S. Verticlosed Turbine Pump Motors



Sloped trench licks cave-ins on Denver waterline

Digging 6 feet deep in loose sandy loam, this Cleveland 240 sloped trench from 90-inch top width to 34-inch bottom width, eliminating serious cave-ins. Picture shows its 30-inch wide, power-shift conveyor easily discharging the large-volume spoil.

Owner Fred Linneman of Denver uses his versatile 240 on many different types of trenching jobs, averages 20 feet of trench per minute on small mains and service lines in this area. Transport is no problem since the 240 is only 8 feet wide overall and its conveyor power folds to within this width.

The Cleveland 240 digs down to 6'3" deep, covers a wide range of trench widths. Get full information now.

Good Everywhere®

The CLEVELAND TRENCHER Co.

20100 St. Clair Avenue • Cleveland 17, Ohio

Equipment News

CONTINUED FROM PAGE 19A

nitely without interior or exterior maintenance.

The unique two-piece Ceilcote design provides substantial savings in the fabrication and erection of the tank. The two Duracor sections will be bonded together into an extremely rigid unit that requires no external support.

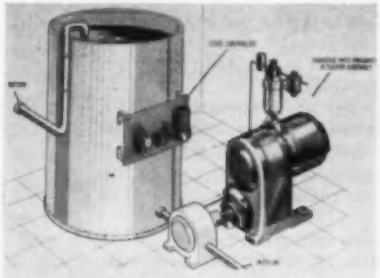
Duracor reinforced plastic was selected for this application because it offers the unusual combination of lighter weight, greater strength and economical design. When erected, the tank will have a 14-foot over-all height and a 14-foot diameter.

Translucent Duracor eliminates the need for the external glass gauge normally used on such tanks. With the installation of an interior lighting fixture, the solution level of the tank can be readily determined at any time, Appurtenances, including the manhole, intake and drain, were fabricated completely from Duracor as an integral part of the tank.

Liquid Level Control

1004

U. S. Electrical Motors, Inc., Los Angeles, Calif., announces that a new liquid level control system has been developed to maintain a constant level



U.S. LIQUID LEVEL CONTROL SYSTEM

in tanks. The system consists of a Varidrive Motor equipped with a pneumatic Varitrol actuator. The Varidrive, receiving a signal from a U. S. Level Controller, automatically provides variable speed to the pump to maintain a constant level within the tank.

This new system is entirely pneumatic and contains no floats or flow restricting valves. Free and steady circulation is maintained for better control of the process.

U. S. Liquid Level Control System provides two methods by which liquid level may be controlled in an open tank—Air Purge and Liquid Purge.

Vinyl Liners for Corrosive Liquids

1005

Bakelite Co., Div. Union Carbide Corp., New York, N. Y., has reported that leakage from wooden water towers and chemical tanks, which has long been a problem, can be overcome easily and economically by the use of a flexible liner that is highly resistant to moisture penetration and attack by most chemicals. The familiar rooftop wooden water tanks can now be made

CONTINUED ON PAGE 23A

outstanding reliability
is normal routine with a
FLOmatcher
sewage pumping system

Six years of problem-free service in over 25 installations have proved the FLOmatcher liquid rheostat system the economical solution to variable flow pumping problems. Because it has almost no moving parts, a year and a half of steady 24-hour operation without maintenance is routine for FLOmatcher. All parts that contact liquids are of proven corrosion resistant materials, insuring 25 years or more of life. In addition, operating costs are reduced with FLOmatcher. Static head and friction head are decreased and wear is minimized through lower average pump speeds and liquid velocity

only gravity moves
sewage as reliably
as a **FLOmatcher**

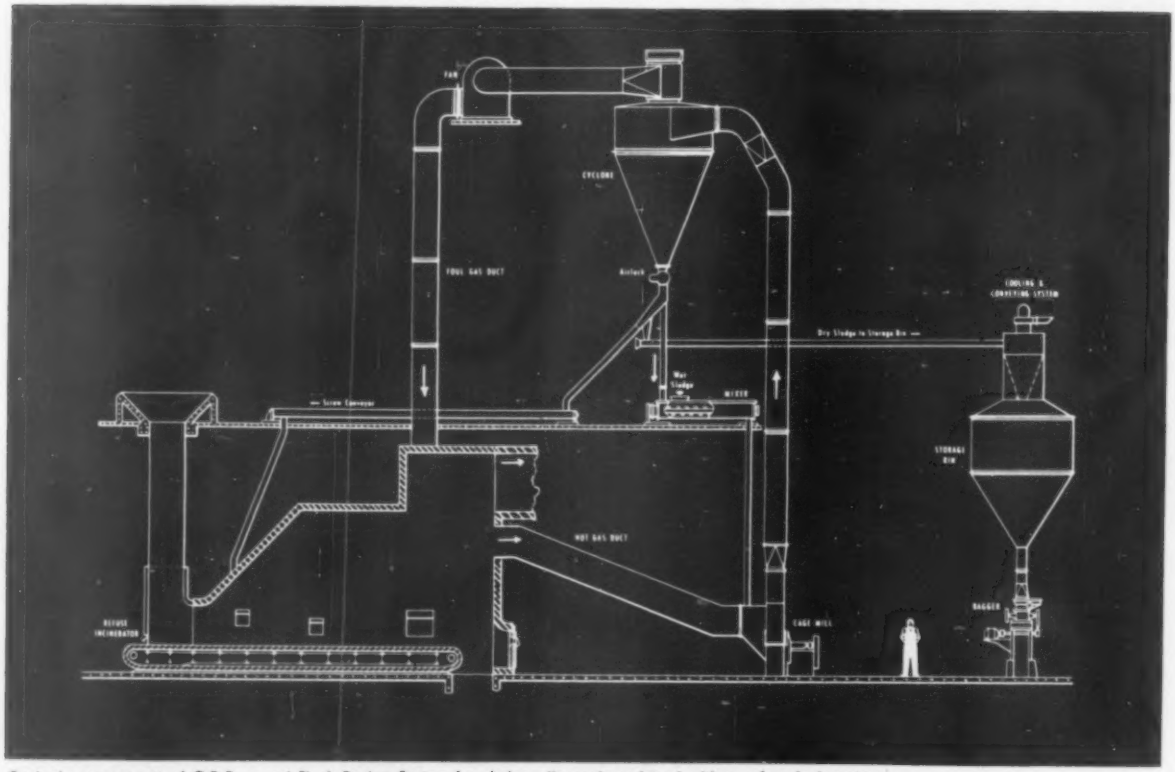
Pumping station, sewage treatment plant, Corvallis, Oregon

a product of
GENERAL SERVICES CO.
CORVALLIS, OREGON

For Full Details on the FLOmatcher Pump Control System, use Reader Service Card or contact:

GEORGE M. OSGOOD CO.
NATIONAL SALES REPRESENTATIVE
Builder's Exchange Bldg., Portland, Oregon • CA 2-1953

Consulting Engineers: Consoer, Townsend & Associates, Chicago
Contractors: Fruin-Colnon Contracting Company and C & C Construction Company (a joint venture) Fort Wayne, Ind.



Typical arrangement of C-E Raymond Flash Drying System for sludge disposal combined with a refuse incinerator incorporating the C-E Traveling Grate Stoker. No-cost heat from the incinerator is used to dry sludge filter cake.

NEW ALBANY, INDIANA chooses C-E

• *for sludge disposal*
• *for refuse incineration*

To meet growth and expansion needs, the City of New Albany has embarked on a $4,200,000 program of sewerage improvement which includes a new primary treatment plant with an average influent flow of 6.13 mgd. Sludge filter cake here will be reduced to approximately 8 per cent moisture content in a C-E Raymond Flash Drying System. *No-cost* heat for drying will be supplied by two 80-ton daily-capacity refuse incinerators using the most modern of refuse firing devices – the C-E Traveling Grate Stoker.

Both of these C-E Systems have been service-proved in installations large and small, and are a combination which furnish a dependable, economical solution to a community's sewage-refuse disposal problem. Not only does the refuse incinerator furnish heat for sludge drying, but the dried product, if not contaminated by industrial wastes, can be sold for use as soil conditioner to help defray plant operating expenses. At New Albany, the Flash Dried sludge will be used as soil conditioner, with any excess being burned in the refuse incinerator.

If your community's needs, now or in the future, call for improved sewage disposal facilities, alone or in combination with refuse disposal, investigate the C-E Raymond System. For detailed information on how this system can benefit your community, contact the C-E office nearest you. Our specialists will be glad to discuss, at no obligation, your requirements with you or your consultants.

MORE SEWAGE SLUDGE IS DRIED AND/OR BURNED IN THE C-E RAYMOND SYSTEM THAN IN ALL OTHER SYSTEMS COMBINED.

COMBUSTION ENGINEERING

RAYMOND DIVISION, 1315 North Branch Street, Chicago 22, Ill.
Eastern Office: 200 Madison Avenue, New York 16, N. Y.
Western Office: 510 West Sixth Street, Los Angeles 14, Calif.

***ATTENTION FSIWA CONVENTION DELEGATES*—Why not stop by booths 29 and 30 and see us. We'll be glad to answer any questions you may have about the Raymond System, and to tell you where you can see our new movie, "Topsoil Unlimited."**

C-182

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

Equipment News

CONTINUED FROM PAGE 21A

virtually leak-proof through the use of long-lasting liners made of Bakelite vinyl sheeting.

Elizabethtown Water Company Consolidated, Elizabeth, N. J., is using these new liners to solve liquid alum storage problem. The corrosive liquid alum and leakage was a problem until the company installed the liners in two 8,000-gallon tanks at its Bound Brook, N. J., station.

Each tank measures twelve feet in diameter and eleven and a half feet high, and vinyl liners were made to order for an exact fit. The packaged liner was opened inside the tank so that the liner would be undamaged when passed through a narrow opening under the roof. One of the first installation steps was to push the built-in nozzle through a hole in the tank bored about six inches from the bottom. After the outlet nozzle is adjusted in place, workmen hold the liner in place and then tack it along the top edge of the tank. Finally the sheeting is smoothed out inside the tank. Although Elizabethtown Water Company uses sheet .020 of an inch thick, film .008 of an inch thick could be used for rooftop water towers. Installation time at Bound Brook for one tank was less than two hours.

New Hydraulic Principle For Circular Settling Tanks

1006

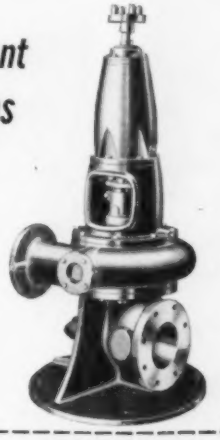
Chain Belt Co., Milwaukee, Wis., after three years of intensive testing, has developed a new circular clarifier that provides a number of important features which assure improved efficiency in circular settling tanks. According to the manufacturer, this new development, called the Rex Rim-Flo, provides maximum hydraulic efficiency, maximum use of tank volume, optimum settling conditions, greatly increased capacity and simple scum removal. Laboratory tests clearly indicate that loadings in excess of twice those of conventional circular clarifiers can be easily accommodated in actual applications.

The Rim-Flo employs a thoroughly proven hydraulic principle to insure most effective settling. The influent is introduced into a feed channel entirely around the periphery of the tank. The channel is preferably of uniform width, with the depth gradually decreasing—from the deepest point at the influent point to the shallowest at the extreme end of the circle. A series of properly sized ports are correctly spaced in the floor of the feed channel. The combination of the tapered channel cross section and spaced ports

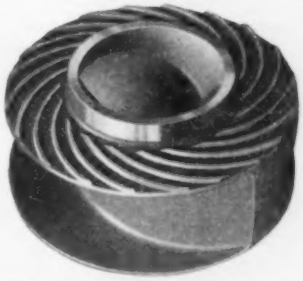
CONTINUED ON PAGE 23A

What to look for when you want low-maintenance sewage pumps

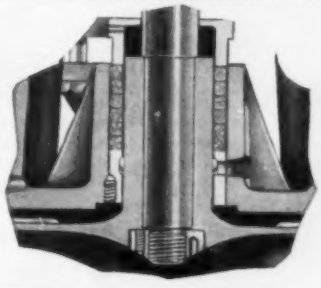
Wheeler-Economy, with half a century experience in the field, finds these are important features:



1. CLEAR, UNOBSTRUCTED, CAREFULLY DESIGNED WATERWAYS allow your pumps to pass exceptionally large rags, sticks, stones and solids without clogging. This 12″ x 10″ Wheeler-Economy Non-Clog Pump, for example, handles 7″ solids easily.



2. NON-CLOG IMPELLERS reduce maintenance, too. This W-E Impeller, a two-blade, wide-waterway type, is locked to shaft with countersunk nut to prevent accumulation of rags, string, etc. Scraper blades are on back to prevent binding.



3. RENEWABLE BRONZE SHOCK ABSORBER prevents shaft deflection as stones or other objects enter impeller. When abrasive material is being handled, clear water connection minimizes wear on shock bearing, shaft sleeve and packing.

LIKE MORE INFORMATION? Ask for Catalog F-100, F-101 and 102, and E-101 describing Wheeler-Economy's complete line of sewage pumps. No obligation.

Economy Pump Division

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pa.

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

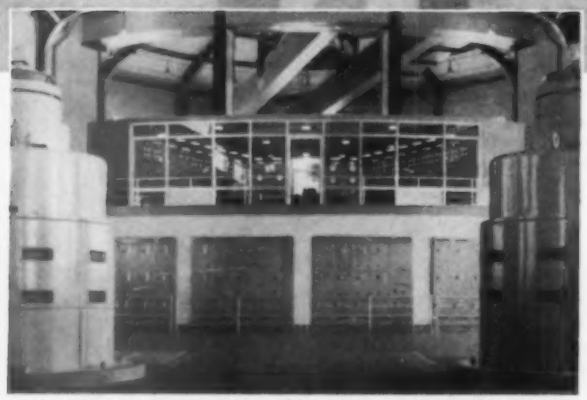
One of two (2) main operating corridors showing individual filter control stations whose modern design permits initiating and carrying out the backwash cycle automatically.

CITY OF DETROIT

Department of Water Supply
NORTHEAST FILTER PLANT & PUMPING STATION
Gerald Remus, Dept. Gen. Mgr.

General Contractors
Bryant & Detweiler, Detroit (Pumping Station & Foundation)
Greve-Sheppard, Wilson & Krug, New York (Filter Bldg.)

Equipment Contractors
Municipal Service Co., Kansas City (Filter Equipment)
Stanley Carter Co., Detroit (Metering Equipment)



A view of the pump controls framed between two of the vertical motors. Enclosed control center contains all instrumentation necessary for monitoring operation of station. Large dial gauges provide continuous indication of station performance.

Plant engineer, George Dehem, inspects an individual filter control station with one of his filter attendants. All filter operation is supervised from this control panel.

ONE SOURCE
ONE RESPONSIBILITY

B-I-F INDUSTRIES
BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA

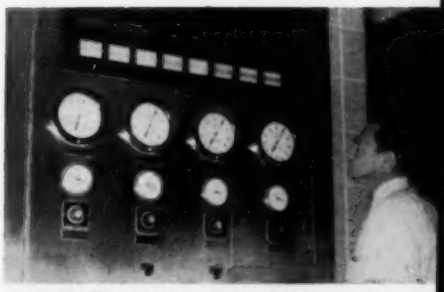
Detroit Equips New Northeast Filter Plant with

INTEGRATED EQUIPMENT OF PROVEN PERFORMANCE FROM "SINGLE RESPONSIBILITY" SOURCE!

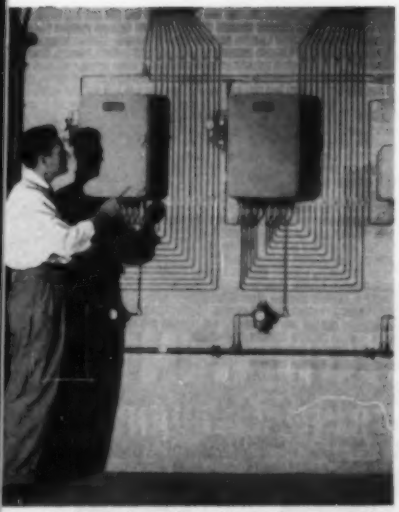
Modern Builders-Providence Controls and Equipment Installed at Detroit's 192,000,000 GPD Water Supply System

Supplying the tremendous water demands of the country's fifth largest municipality is no small task. The complex nature of such an operation requires complete integration of all control equipment . . . for maximum efficiency, operation economy and systems reliability.

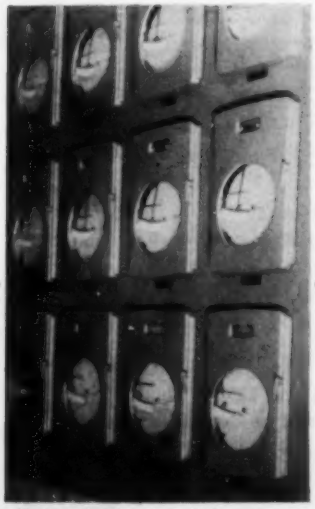
B-I-F Industries as a single, responsible source . . . offering nationwide sales and service through local offices . . . was able to supply the type of equipment (supervisory control, filter control, chemical feeding and related functions) that means immediate and long term savings in time and money. For particulars, write **B-I-F Industries, Inc., 350 Harris Ave., Providence, Rhode Island.**



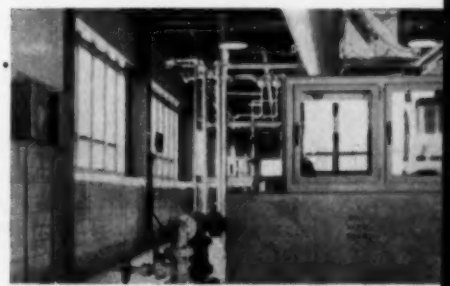
From this filter master control and annunciator panel, the flows through four batteries of twelve filters each can be observed and regulated to meet varying demands. Audible alarms and lights indicate any departure from desired conditions . . . allow operator to maintain optimum operation.



Each of these filter effluent flow summation units totalizes the flows through 12 individual filters and transmits a signal proportional to total flow to instruments located at key locations throughout the plant. In addition, the output of the four summation units is added to obtain total plant flow.



All plant functions for which permanent operating records are required are displayed on this central recorder panel thus permitting operating personnel to note trends of the various functions and departures from normal conditions.



One of the Omega Gravimetric feeders used for alum — others are used for activated carbon. These units provide reliable and accurate proportioning of chemicals to water being treated regardless of plant output variation.

In CANTON, OHIO*

TYLOX

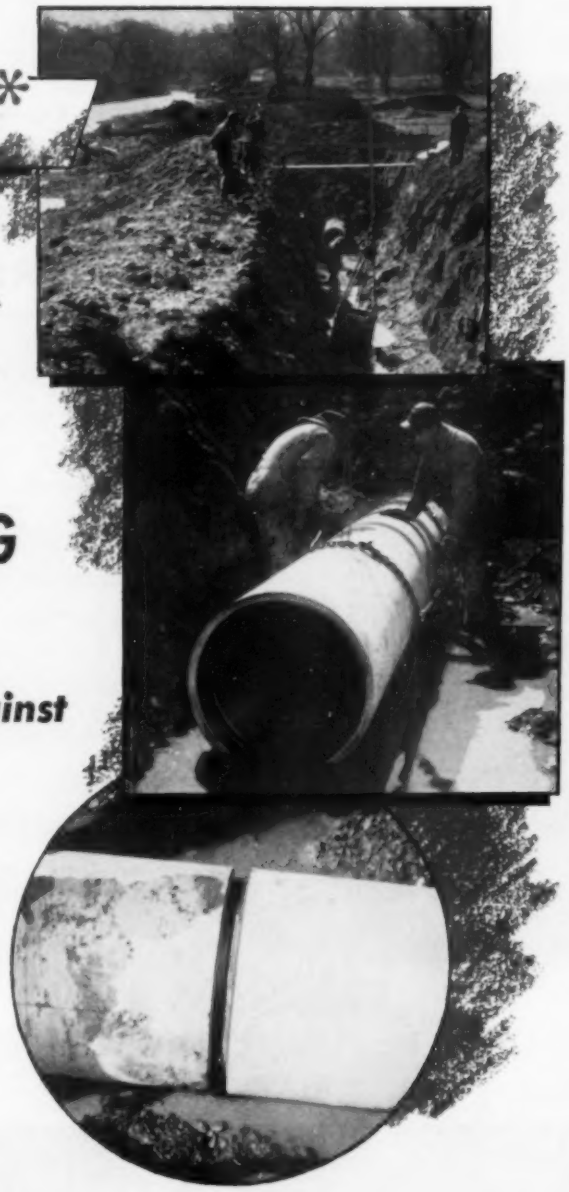
RUBBER PIPE JOINTS

and

REXON PIPE COATING

"team up"

to prevent leaks and guard against corrosion of new city sewers



Engineers had their eyes on future as well as present costs when they designed Canton's recent sewer expansion project. Here's how their call for TYLOX-jointed, REXON-coated concrete pipe helps assure Canton citizens of "most for the money" from their tax dollar . . .

NO JOINT LEAKS — even under tough conditions like those shown in the top photo. TYLOX prevents infiltration . . . keeps treatment plant loads at a minimum . . . eliminates root and sediment penetration.

NO ACID ATTACK — even though industrial wastes may enter the line. REXON Coating (center photo) is resistant to virtually all acids, alkalies, greases and solvents. "Teamed up" with equally durable TYLOX Joints, the resulting line is corrosion-resistant *throughout*.

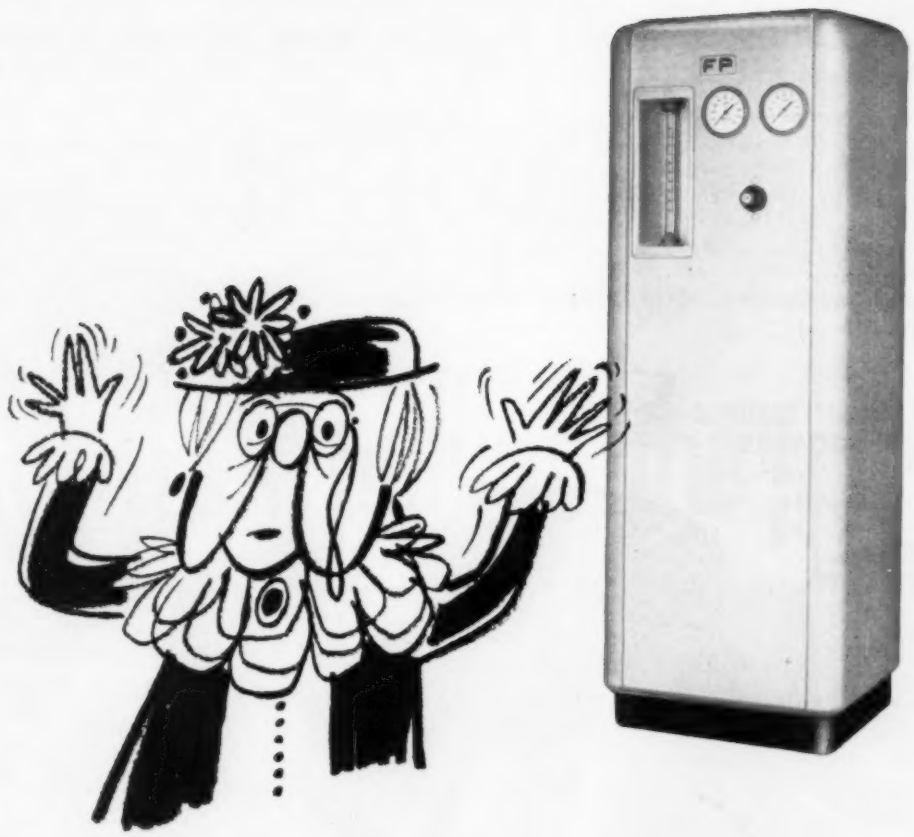
FAST PIPE-LAYING — Just shove gasketed pipe home (lower photo) and the TYLOX Joint is complete. Wet trenches do not delay the work, and the *flexible* TYLOX permits immediate backfilling.

Plan now to specify TYLOX Rubber Joints and REXON Pipe Coating on your next concrete pipe job and be assured of leakproof, corrosion-resistant lines laid faster . . . Write for more details today.

* **PROJECT:** Stark County sewer expansion project, Canton, Ohio
ENGINEER: A. T. Holl, Stark County Sanitary Engineer
CONTRACTOR: Shullo Construction Co., Akron, Ohio
PIPE: Reinforced concrete, TYLOX-Jointed and REXON Coated, manufactured by United States Concrete Pipe Company, Cleveland, Ohio.

3062

HAMILTON KENT MANUFACTURING COMPANY
KENT, OHIO
427 West Grant St. ORchard 3-9555



All that fuss about a well...

Seems that one day they tested the town well and said it was polluted. Imagine! Our well . . . polluted! Why that well had been serving our town water since Hector was a pup.

So they had a big fuss and then they built a little shed and put a chlorinator in it. Well, they claimed the water was pure, but it tasted *awful*. And the smell around that shed gave the whole town a bad name. Of course, that was only half the time . . . it was being repaired the other half.

Then we gave up. Put in a new kind of chlorinator made by a company I never heard of . . . Fischer & Porter. Talk about spic and span! You could eat off that box. And not only is the smell gone, but believe it or not, the water *tastes* better. They say it's even safer.*

Now you don't have to take *my* word for it. If you're a suspicious kind of person you can get all the proof you want by writing to Fischer & Porter Company, 208 Fischer Road, Hatboro, Pennsylvania.

FISCHER & PORTER CO.

Instrumentation and Chlorination

*Any wonder everyone's *trying* to copy F&P's design now?

Equipment News

CONTINUED FROM PAGE 23A

assures a uniform forward-flow velocity in the channel, even though the volume decreases as each port takes its proper share of the total flow. This controlled horizontal-flow velocity prevents any settling out of solids in the feed channel and assures the transportation of all scum to the end of the feed channel for collection.

Indoor Meter is Read Outdoors

1007

Badger Meter Mfg. Co., Milwaukee, Wis., has developed a revolutionary water meter register that brings meter reading "out in the open."

Designed to prove a boon to utilities, meter readers and homeowners, the new device is called "Read-o-Matic." The register can be placed as far as one-half mile away from the meter and still accurately record the flow of water (or any other fluid) through the meter. Extensive tests showed that accurate readings were possible at temperatures as low as 25 degrees below zero.

By separating the metering from the reading, and bringing the register itself out of the house, faster and lower cost reading is now possible, according to Badger engineers. The new device also would do away with estimated bills that are now issued by some utilities.

Simple to install, the outside register needs only a doorbell type wire as a connection to the meter. The extremely low voltage of the self-powered register permits safe unrestricted installation. No outside power source is required. This wire carries the impulses from a small rugged self-contained generator atop the meter to the register outside the home.

The register, remains a permanent part of the installation, even if the meter requires repair or replacement.

The new register may be applied to most U. S. makes of water and industrial fluid meters, not only water meters but any meter that measures liquids, including compound and turbine meters of any size.

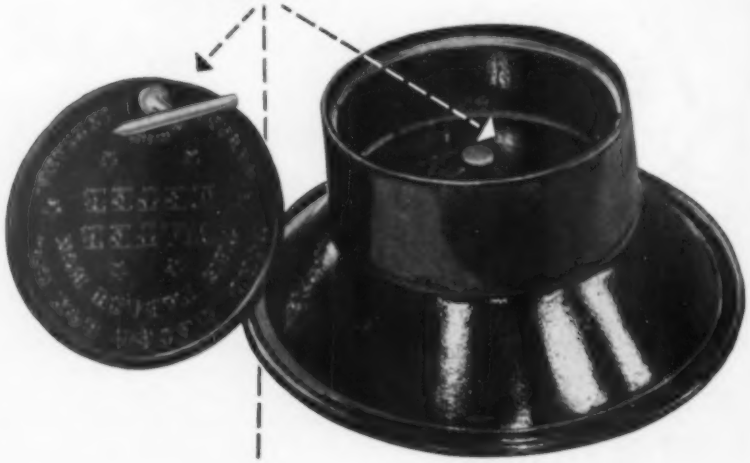
Time Switch for Programming Sewage Disposal

1008

Tork Time Controls, Inc., Mount Vernon, N. Y., has developed a model #4100 time switch, called the Hourmaster, for use in sewerage and sew-

CONTINUED ON PAGE 33A

WABASH DOUBLE-LID COVERS



for MAXIMUM PROTECTION from frost

WRITE FOR CATALOG

The new No. 56 Ford Catalog contains full information. FREE. Send today.

The Wabash Cover was designed to provide the utmost in frost protection for pit water meters. Two lids, with a 4" dead air space between, add extra insulation. Notice also, the extra depth and the sloping skirt that help hold heat loss to a minimum.

Top lid is inset and locked with the patented Ford Lifter Worm Lock. There is no finer meter setting protection.

FOR BETTER WATER SERVICES

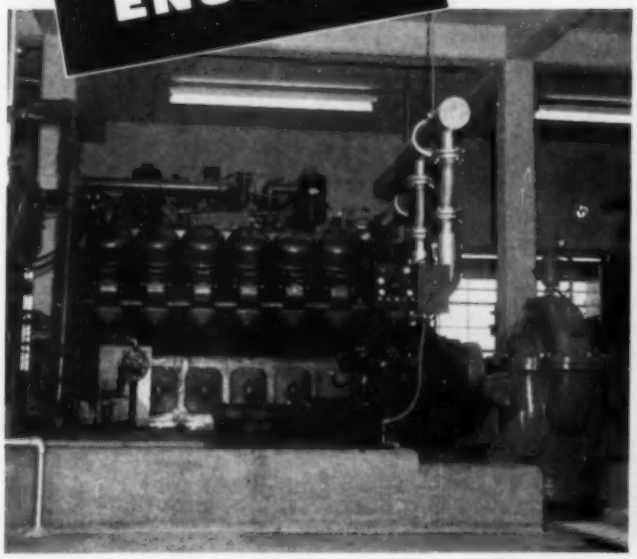
FORD

Manufactured by THE FORD METER BOX COMPANY, INC.

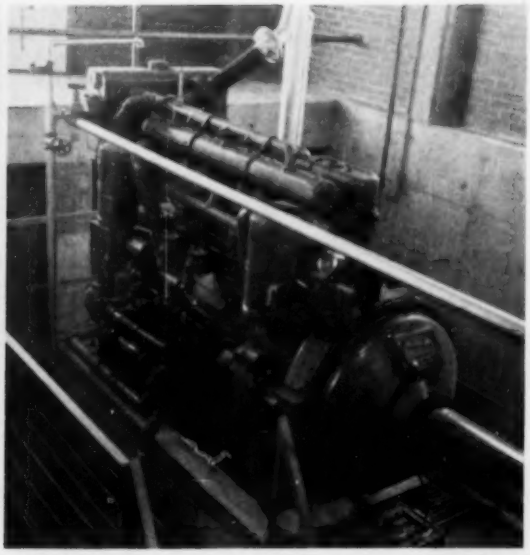
Wabash, Indiana

Oklahoma City's Lake Hefner Municipal Filtration Plant

...has three ROILINE ENGINES pulling the pumps



Model L-3460, max. hp 595 at 1350 rpm on natural gas



Model F-1500, max. hp 215 at 1200 rpm on natural gas

• The municipal filtration plant of Oklahoma City, Okla. at Lake Hefner has three *Roiline* engines pulling the pumps. Pictured above are two Model L-3460 *Roilines* (max. hp 595 at 1350 rpm on natural gas) each engine pulling a ten million gallon Gould pump; and a Model F-1500 *Roiline* engine (max. hp 215 at 1200 rpm on natural gas) operating a fifteen million gallon Peerless Hydrafoil at low lift pump station. In addition, but not illustrated, is a Model L-3000 *Roiline* engine driving a 250 KVA generator. The Carson Machine & Supply Co, of Oklahoma City, Okla., made the installation. Send for Bulletins. 395

WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

NEW YORK • TULSA • LOS ANGELES

DOLLAR

Ash disposal line for power plant in Alabama, being constructed with 12" Mechanical Joint Cast Iron Pipe.

Big Business, too, chooses Cast Iron Pipe

Fire protection line for large automotive plant in New Jersey, built with Mechanical Joint Cast Iron Pipe.

MODERNIZED **cast iron**

FOR DOLLAR

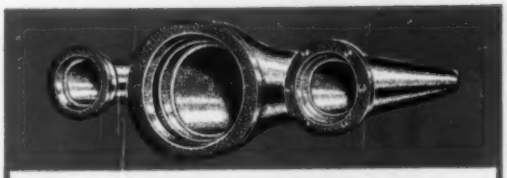
Cast Iron Pipe delivers MORE water...LONGER!

Pipe is a capital investment.

But cast iron pipe is an investment that pays off.

- *In longer life* . . . cast iron pipe serves for centuries.
- *In more efficient operation* . . . cast iron pipe requires little or no maintenance or replacement.
- *In taxpayer satisfaction* . . . cast iron pipe far outlasts the bond issue that paid for it.

Most important to you, these statements are based on proof, not claims . . . performance, not promise. Specify cast iron pipe, America's most dependable pipe, and be sure, not sorry.



6 reasons why Cast Iron Pipe is #1 choice of U.S.A.

1. **HIGH FLOW CAPACITY . . .** Cement lined cast iron pipe and fittings will not tuberculate . . . delivers a full flow for the life of the pipe.
2. **LONG LIFE . . .** 42 North American cities are still using cast iron water mains laid 100 years and more ago. Hundreds more have passed the 50 year mark.
3. **BEAM STRENGTH . . .** Cast Iron Pipe is inherently tough . . . stands up under heavy traffic load, soil displacement and disturbance.
4. **EXTERNAL LOAD RESISTANCE . . .** 6" Class 150 Pipe withstands a crushing load of 17,900 pounds per foot . . . nearly 9 tons.
5. **CORROSION RESISTANCE . . .** Cast Iron Pipe effectively resists corrosion . . . vital factor in its long life and dependability.
6. **TIGHT JOINTS . . .** A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available for all conditions.

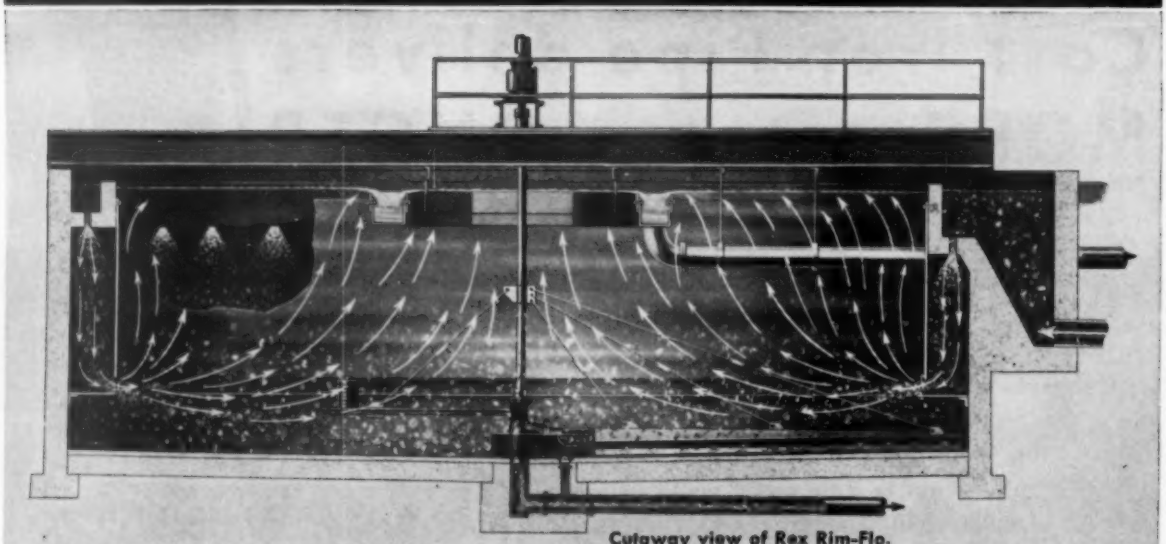
THE MAN WHO CHOOSES CAST IRON PIPE TODAY WON'T PAY FOR IT AGAIN TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

pipe FOR MODERN WATER WORKS

The new REX® Rim-Flo Clarifier



Cutaway view of Rex Rim-Flo.

A NEW HYDRAULIC PRINCIPLE FOR...

- Maximum Hydraulic Efficiency
- Maximum Use of Tank Volume
- Optimum Settling Conditions
- Greatly Increased Capacity
- Simple Scum Removal

IN CIRCULAR TANKS

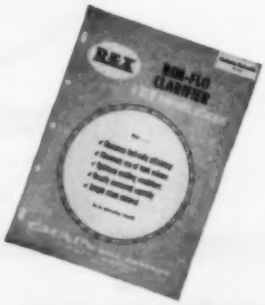
Simplified cutaway view of Rex Rim-Flo illustrating flow patterns.

The Rex Rim-Flo Clarifier brings a new high in efficiency...a new high in performance to circular settling tanks.

The unique, thoroughly proven hydraulic principle of the Rim-Flo introduces the influent into a circular feed channel entirely around the periphery of the tank. The channel is of uniform width but the depth gradually decreases from the deepest point at the influent point to the shallowest at the extreme end of the circle. A series of properly sized ports are correctly spaced in the floor of the feed channel. This combination of tapered-channel cross section and spaced ports assures a uniform forward-flow velocity in the channel, even though the volume decreases as each port takes its share of the flow. This controlled flow velocity prevents any settling out of solids in the channel and assures transportation of all scum to the end of the channel for collection.

The ports direct the flow downward into the tank between the tank wall and a vertical skirt. The flow approaching the tank bottom is at an extremely low velocity and is directed into the main body of the tank. Solids promptly drop out of suspension onto the tank floor. The flow is directed gently upwards to a central effluent trough.

Rex Rim-Flo is the practical economical solution to the problem of outmoded or overloaded circular settling tanks. Rim-Flo can be adapted to existing circular tanks of practically any size.



For additional information on Rex Rim-Flo or any of the other *plus value* Rex Equipment, write CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

CHAIN BELT

Equipment News

CONTINUED FROM PAGE 28A

age disposal plants. Designed for intermittent-operation control, the unit is equipped with both a 1-hour and 24-hour dial, offering extremely fine and accurate selectivity.

The 1-hour dial is designed to turn ON on-the-hour and turn OFF as set, after 2 to 55 minutes—only at the hours selected on the 24-hour dial. Adjustable in 1 minute periods, operation can be set for any and all hours of the day.

The Hourmaster simplifies the setting of day and night programs in sewage disposal—with frequent ON action for sludge pumps and rake bar screens during peak periods, and less frequent operation at other hours. Programs can be reset as needed, by adjusting set screws and trippers. No tools are needed for the resetting of schedules.

Equipped with Heavy Duty dustproof motor with a temperature range of from —60° to +160°F, the Hourmaster carries a 30 Amp 1 hp rating. In Standard, Dust-Tight, Rain-Tight, or Submersible Enclosures, the unit is available in both Single Pole and Double Pole models, in 120 volts or 208-240 volts.

New Pipe Cutter, Cuts Clean, Quick, Accurately

1009

Wheeler Mfg. Co., Ashtabula, Ohio, has developed a completely new type

of cutter for standard or extra-heavy soil pipe, field tile, vitreous tile, flue lines (square or round), transite and duriron.

The Wheeler Pipe Cutter is easily used by one man—requires no vise or turning. Operator wraps the chain around the pipe, pulls the handle, and cleanly cuts any standard or extra-heavy soil pipe or tile, 2″ through 4″. By adding an extra chain, operator can cut 6″ extra-heavy soil pipe or 15″ tile. Once adjustment is made, any number of cuts can be made without further adjustment.

According to the manufacturer, the Wheeler Cutter takes just 10 seconds to operate, cuts cleanly without breakage, can cut slices as narrow as ¾″, and is easy to use in close quarters or blind spots.

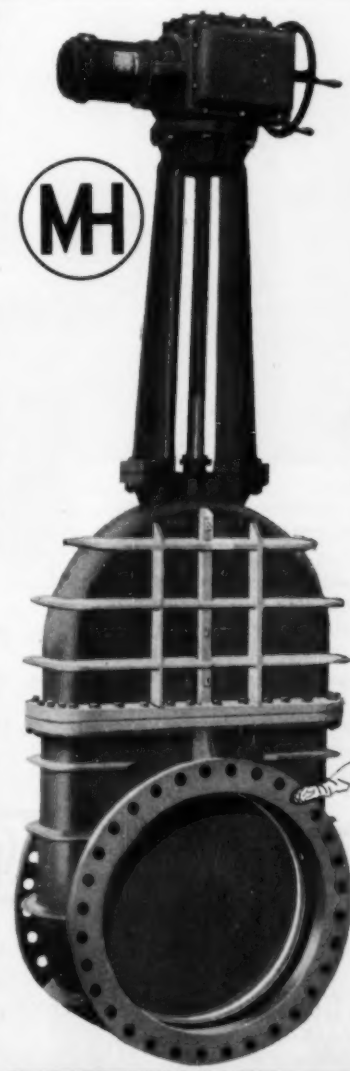
The manufacturer also states that the Wheeler Cutter is sturdily built, with forged steel jaws, for long life.

Pneumatic Positioner For Automatic Chlorinator Control

1010

Wallace & Tiernan, Inc., Belleville, N. J., has developed an effective new positioner that varies chlorinator feed rate automaticallly in proportion to a standard 3 to 15 psi pneumatic signal.

CONTINUED ON PAGE 35A



Motor Operation

FOR BIG VALVES

Remote operation and control of valves by electric motors is not only a great convenience but frequently increases efficiency and reduces operating costs. Electric motor operation is recommended for valves which are frequently operated or valves which are located in remote or inaccessible or hazardous places. (If preferred, M & H cylinder operated valves may be used for similar service.)

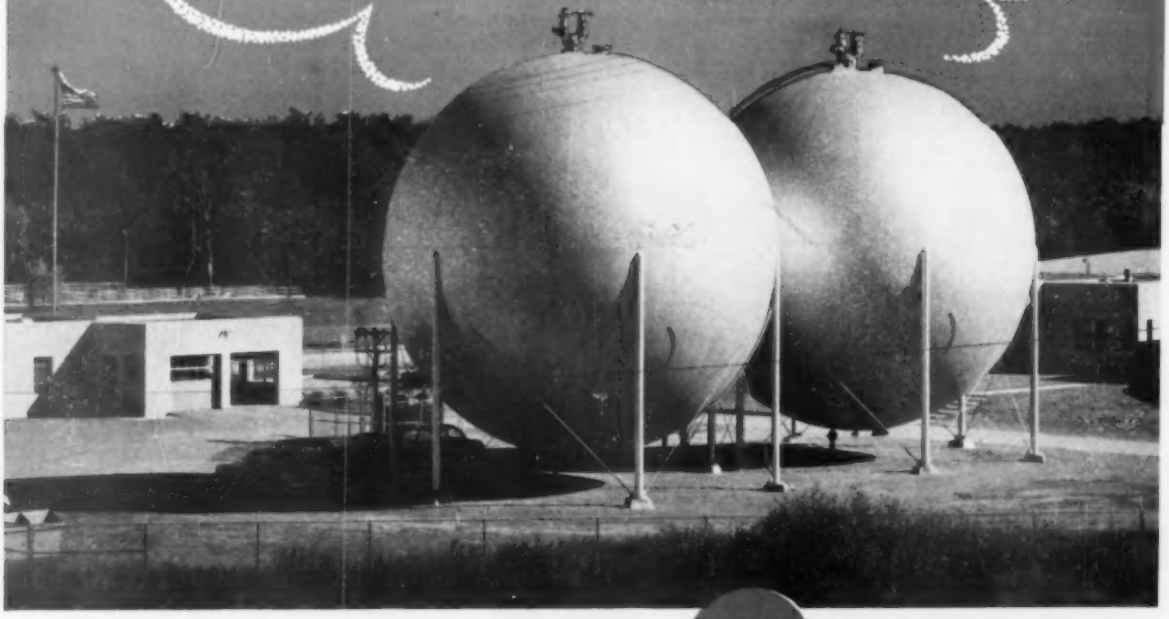
All types of M & H Gate Valves are available with electric motors installed on the operating mechanism. They are standard M & H valve design and construction, i. e., iron body, bronze mounted, double disc, parallel seat, or solid wedge as desired. Illustrated at the left is a low pressure 36-inch motor-operated M & H Valve. For detailed information, *write or telephone* . . .

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

HORTONSPHERES®

help reduce operating costs at South Bend treatment plant



South Bend, Indiana's sewage treatment system uses digester gas as low-cost fuel to drive sewage pumps and air compressors.

To equalize the variable gas production with demand, CB&I furnished these two 45 ft. diameter Hortonspheres®. Excess gas is stored in them at 40 lbs. per square inch working pressure—and released according to demand.

Hortonspheres are in demand *wherever* progressive operators seek to reduce sewage plant operating costs, for two reasons: Hortonspheres store *more* in *less* space; and, their performance is backed by seven decades of CB&I's craftsmanship in the design, fabrication and erection of steel plate structures.

Write your nearest CB&I office for details on Hortonspheres—for either digester gas or municipal gas service.

3 WAYS SEWAGE PLANTS SAVE with HORTONSPHERES

- Store more . . . in less space
- Smooth out pressure variations
- Provide peak load gas reserves

CB&I

M50C

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PA. and at NEW CASTLE, DELAWARE.
In Canada: HORTON STEEL WORKS LTD., TORONTO, ONTARIO

Continuing improvements by CB&I in design, testing, fabricating, and erection techniques and equipment — plus new tougher steels with higher yield strength, have considerably extended the volume of gas that can now be stored at high pressure.

Equipment News

CONTINUED FROM PAGE 33A

The Pneumatic V-notch Positioner is designed for use with W & T V-notch Chlorinators. This control device converts air-pressure signals from any standard pneumatic transmitter or air-pressure regulator to a mechanical movement. This movement positions the V-notch Variable-Orifice, thus varying chlorinator feed rate automatically. The V-notch Positioner provides a simple but effective way to achieve remote-manual, program, step-rate, or automatic-flow proportional chlorinator control. Working parts of the Positioner are contained in a corrosion-proof plastic case, air purged to prevent internal corrosion.

The Pneumatic V-notch Positioner is a compact unit mounted inside the chlorinator cabinet. Installation is simple: no change in the chlorinator itself is necessary. A pneumatic recorder may be used with the V-notch Positioner to provide a permanent record of the chlorine flow.

New K & M Sewer Pipe Fittings

1011

Keasbey & Mattison Co., Ambler, Pa., has announced that installation of

asbestos-cement gravity sewer systems has been greatly simplified through the use of the company's one-piece "TEE" and "WYE" socketed fittings recently developed.

Available in a variety of sizes, the new fittings materially hasten pipe laying by providing two socket ends into which the main sewer trunk can be easily inserted using K & M's exclusive Fluidtite gaskets.

Moreover, by using K & M's asbestos-cement building sewer end caps, provision can be made for future connections in areas zoned for residential development. The socketed fittings are incorporated into the line during the construction, with the end caps sealing off the branches until needed.

The new fittings are available in diameter of 6, 8, 10 and 12 inches with lateral branches of 4 and 6 inch diameters.

Universal Electronic Recorder

1012

The Hays Corp., Michigan City, Ind., has developed a new circular chart recorder.

With a maximum of four records

CONTINUED ON PAGE 37A

the Big 4
PENNSALT CHEMICALS
FOR WATER AND SEWAGE TREATMENT

Aerial view of the modern new sewage treatment plant at Eugene, Oregon.

CHLORINE. A uniform quality waterworks grade of chlorine. Used by hundreds of cities and communities throughout the country because of confidence in PENNSALT'S Quality Control of the product. Shipped in 100 and 150 lb. cylinders and ton containers by rail, truck and water.

AMMONIA, Anhydrous. Waterworks grade, shipped in modern, lightweight cylinders which saves considerable freight cost and lightens the burden of handling. 50, 100, 150 lb. cylinders.

PERCHLORON. High-test calcium hypochlorite containing 70% available chlorine. Shipped in 100 lb. drums; cases—nine 5-lb. cans to a case.

FERRIC CHLORIDE, Anhydrous. Use of PENNSALT'S Ferric Chloride in sewage disposal operations simplifies and improves performance. It provides immediate filtration without the usual losses in sedimentation time in the treatment of fresh or digested sludge. Increases filter efficiency and multiplies vacuum-filter capacities through superior coagulation. Available in non-returnable steel drums of 135 and 350 lbs.

PENNSALT OF WASHINGTON DIVISION

PENNSALT CHEMICALS CORPORATION
TACOMA, WASHINGTON

Save time—for fast service call the nearest PENNSALT OFFICE

Tacoma, MA 7-9101 — Menlo Park, DAvenport 6-8290
Los Angeles, LUdlow 7-6244 — Portland, CApitol 8-7655
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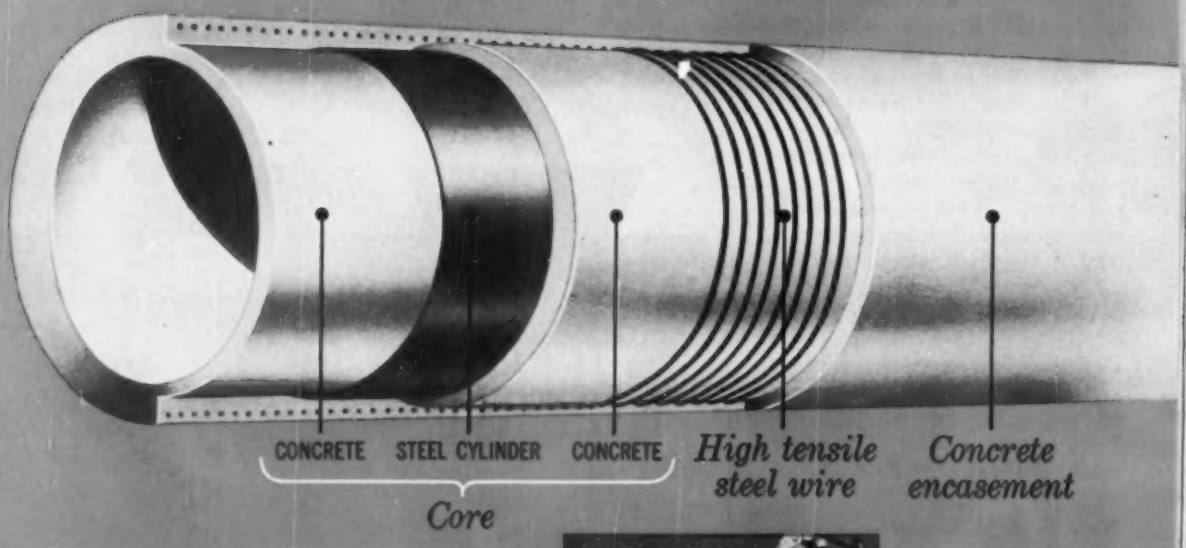
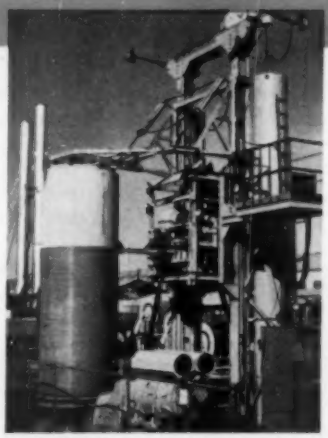
Pennsalt Chemicals
ESTABLISHED 1850

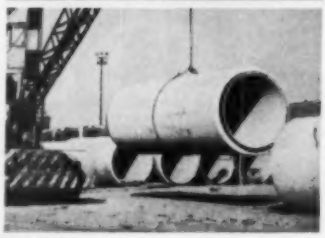
PRESTRESSED
CONCRETE CYLINDER PIPE
(Embedded Cylinder Type)

with Rubber Gasket Joint



All of the good qualities and characteristics desired by water works engineers for permanent water supply and transmission lines are embodied in this prestressed pipe of advanced design: great strength, sustained high carrying capacity, trouble-free service, and unusually long life. Prestressed pipe of this type can be designed more accurately, predictably and economically for most all conditions of internal pressure and external loads than any other type of high quality concrete pressure pipe. It is the finest quality pipe available in medium and large diameters for pressures generally ranging from 100 psi upward. American is currently undertaking the manufacture of this pipe designed for pressures ranging from 275 to 550 ft. of head for a portion of the U.S. Bureau of Reclamation Project being constructed for the Ventura River Municipal Water District. This Ventura River Project will serve 32 square miles of mountainous country with water for irrigation, municipal and industrial use in main and coastal reaches of Ventura County, California. When planning *your* future water "growth lines," look to American's quality pipe line products, extensive production facilities and half century of experience.





Prestressing machine wraps high tensile steel wire under carefully measured tension around pipe core.

American PIPE AND CONSTRUCTION CO.

LOS ANGELES: 4635 Firestone Blvd., South Gate, Calif. LOrain 4-2511
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CONCRETE PIPE FOR MAIN WATER SUPPLY LINES, STORM AND SANITARY SEWERS, SUBAQUEOUS LINES

Equipment News

CONTINUED FROM PAGE 35A

possible on one circular chart, the new recorder has a number of unusual features. Unlike most strip chart potentiometer type recorders, electronic receiver units which can correct for non-linearity of input signals. This one feature permits the use of the Universal Electronic Recorder with as many as four non-linear inputs. Inputs such as flow, gas analysis, pH, pressure, etc., can be handled on a single equally divided chart.

A new feature in conjunction with the potentiometer circuit applications is the Hays constant voltage source. This voltage source is extremely stable; only ± 0.05% variation for ± 20% supply voltage fluctuation. No standard cell or dry cell batteries are required. The device contains no electronic tubes.

Further versatility of the instrument is gained through the addition of directly actuated pressure and/or temperature receivers. These receivers are bellows or Bourdon springs for pressure measurement and gas-filled type Bourdon springs for temperature measurement.

Self-Priming Centrifugal Pumps

1013

Worthington Corp., Harrison, N. J., has announced the addition of two new size models of contractors' pumps to its 1958 line, with several units of greater capacity soon to be released.

Models 15M and 20M, now available, both incorporate a replaceable cast iron recirculation port that eliminates valves and permits renewal of internal clearance. These self-priming centrifugal pumps are engine driven, but are also available as motor driven units. Other features of the new models include a constant-pressure automatic grease lubricator; hydraulically balanced open impeller; replaceable cast iron wear plate; heavy-duty gasoline engine.

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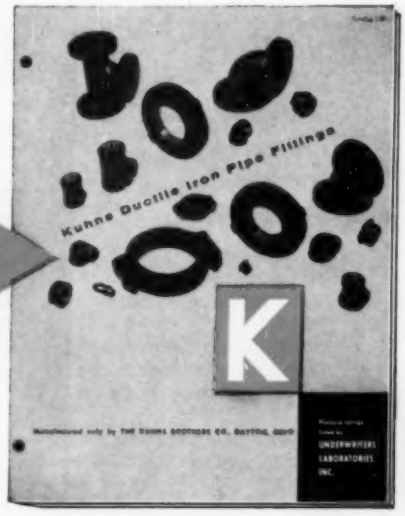

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- Typical applications
- Safety factors and service ratings by Underwriters' Laboratories, Inc.
- Prices
- Physical properties; production control tests
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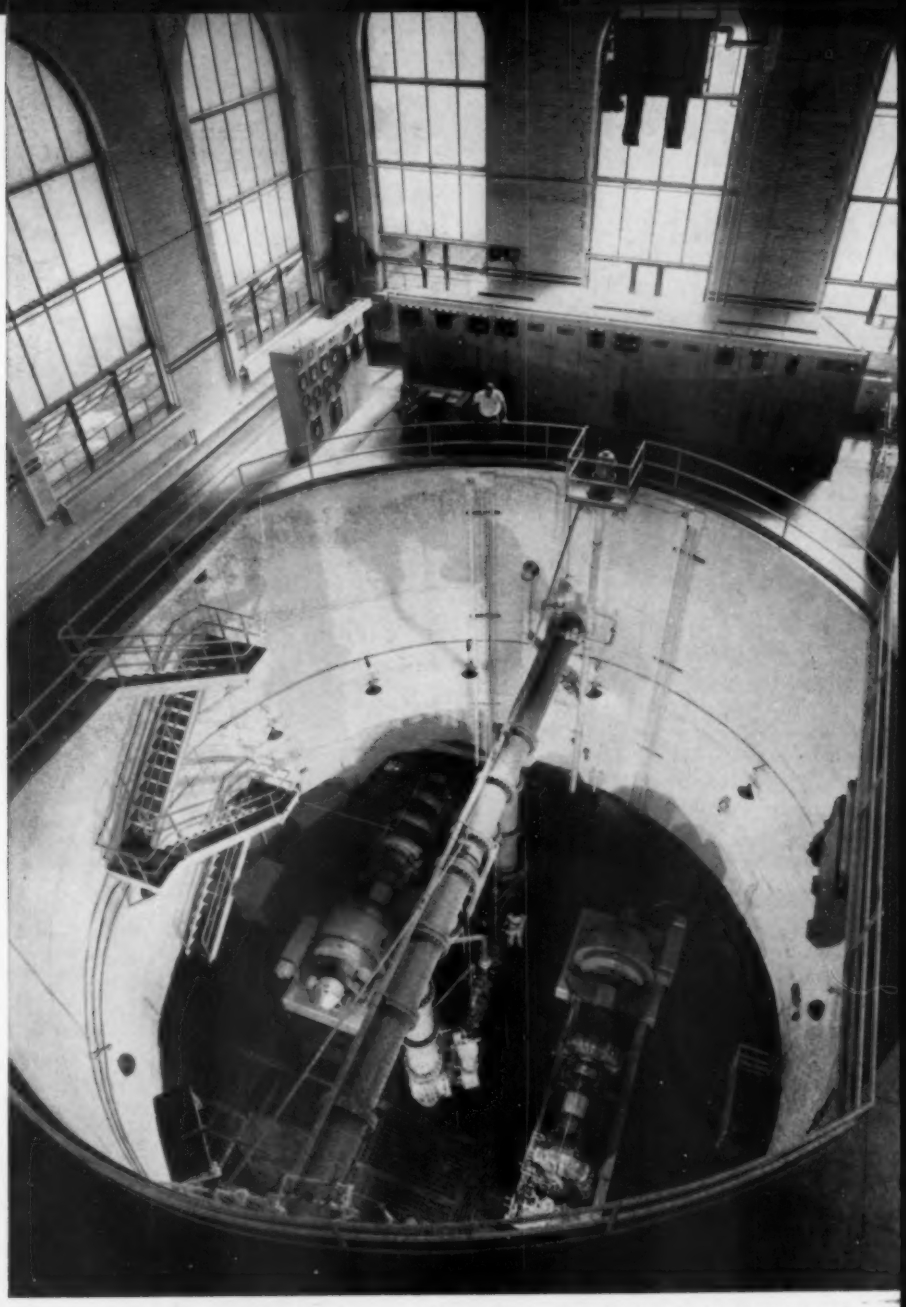
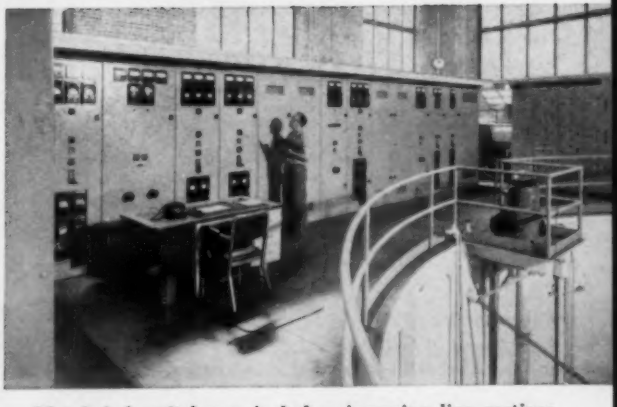


View at Nadine Pumping Station shows south pump pit containing pumps No. 2 and No. 3 with Westinghouse metal-clad switchgear and control center for all station pump motors in background.

Close-up view in booster station shows two 40-hp Westinghouse motor-driven booster pumps, Westinghouse safety switches, motor starters and power factor correction capacitor.



Metal-clad switchgear includes: incoming line section; starting breakers for 1000- and 1250-hp synchronous motors and their auxiliary field control cubicles; starting and running breakers and reactors for two 2500-hp motors.

Water pumping station saves $66,500 annually by Powering-Up electrically

The need for extensive modernization and expansion of water pumping facilities at Nadine Pumping Station of The Wilkinsburg-Penn Joint Water Authority brought about a complete change from steam to electric motor-driven pumps. One new 6.5-mgd pump was added to the three already in use to increase total capacity to 52,000,000 gallons per day.

In addition to the benefits of increased capacity and complete station electrification, comparative figures show a reduction in annual operating costs from approximately $268,000 to $201,500, for a savings of $66,500 per year. This represents an annual return of about 19% on the modernization cost of approximately $350,000. This fast five-year amortization of the investment eliminated the necessity of bond issues or other financing.

Besides the four new pump motors supplied by Westinghouse, the station now contains a line-up of 5-kv metal-clad switchgear, a 150-kva dry-type power center transformer, a motor control center for auxiliary power and a station battery and automatic battery charger.

The electrical Powering-Up of this pumping station has also made possible a more flexible discharge piping arrangement and the electric operation of valves and other equipment.

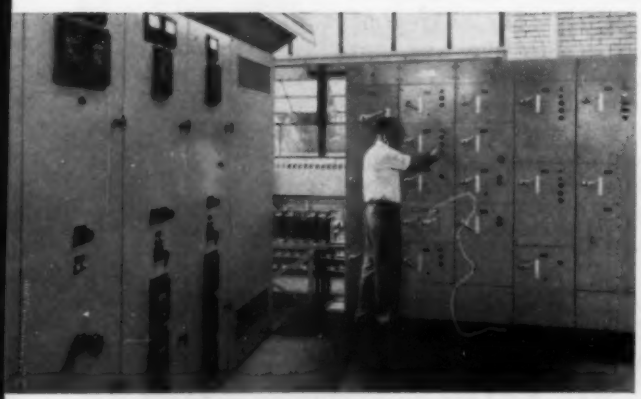
Powering-Up electrically can mean similar important benefits and savings for you. For further information, call the Westinghouse electrical construction engineer nearest you. He can help you in your Power-Up program. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

Owner: The Wilkinsburg-Penn Joint Water Authority
Consulting Engineers: Morris Knowles, Incorporated
General Contractors: Dravo Corporation
Electrical Contractor: Morganstern Electric Co., Incorporated

J-94088

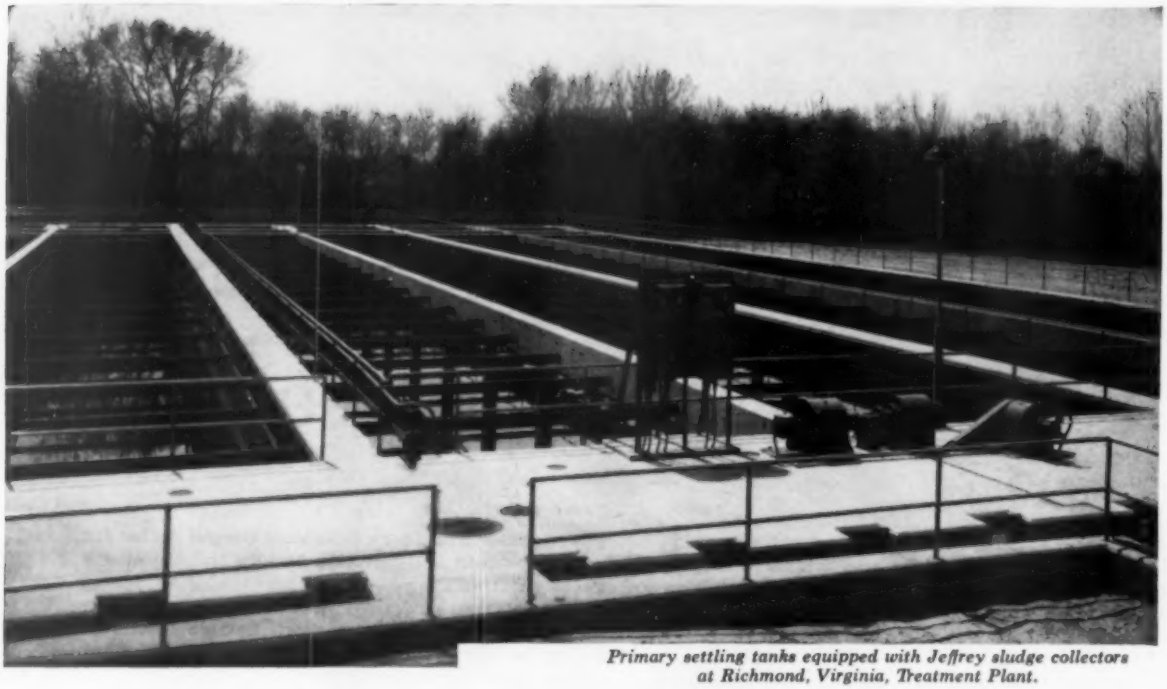
YOU CAN BE SURE...IF IT'S Westinghouse

Over 250 Pages Westinghouse Data In Sweet's Construction File.



Shown at left is metal-clad switchgear feeder cubicle and 150-kva dry-type transformer. Motor control center at right contains motor starters and feeder breakers for various station auxiliaries.

Engineering group shown includes: George A. Maibach, Chief Engineer, Nadine Pumping Station; G. V. Gustafson, Morris Knowles, Inc., Consulting Engineers; M. B. Trimble, Westinghouse Construction Sales Engineer.



Primary settling tanks equipped with Jeffrey sludge collectors at Richmond, Virginia, Treatment Plant.

Jeffrey waste treatment plant prepares Richmond for 2000 A.D.

Jeffrey mechanically-cleaned bar screens with screenings grinders at Richmond plant. Grit is received from V-bucket type collectors, and washed by Jigrit washer.

Can a treatment plant, operating at optimum efficiency in 1958, be just as efficient in 2000 A.D.? The City of Richmond, Virginia, thinks it can:

New Jeffrey-equipped primary treatment plant satisfies current needs with a dry weather flow of 28 mgd. As designed by consultants, Greenley and Hansen, the plant may be easily converted to 70 mgd. secondary treatment, based on a population of 330,000 by the year 2000. Thus an intelligent, long-range plan provides Richmond with a system geared for today, yet fully adaptable to the more-than-double capacity needed for tomorrow.

Jeffrey's line of treatment plant equipment includes bar, disc and traveling water screens, grinders, collectors, washers, scum removers, feeders and FLOCTROLS (controlled flocculation). Catalog 905 describes this and other equipment for water, sewage and industrial waste treatment. The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

New Bulletins *Available Free*

Hydrogen Zeolite Softener

1014

Cochrane Corp., Philadelphia, Pa., has announced the publication of a new eight-page Bulletin on the hydrogen zeolite process. Bulletin indicates advantages of the process, its chemistry and variations in methods for neutralizing mineral acidity of hydrogen zeolite effluent. Types of zeolites are discussed as well as relative advantages and disadvantages of various regenerants. Bulletin also contains a brief description of decarbonators.

Clay Pipe Folder

1015

Robinson Clay Product Co., Akron, Ohio, has just published a new folder, describing Wedge-Lock Clay Pipe, entitled "Lock Tight Like a Railroad Coupling."

This file size folder illustrates simple installation procedures and offers complete information on the time-tested qualities of vitrified clay pipe with corrosion-resistant, factory-made Wedge-Lock plastic joints.

Valves

1016

The Ohio Injector Company, Wadsworth, Ohio, has just published a new condensed version of their General Catalog which lists the company's complete line of valves.

Now available for distribution, this catalog lists over 5 per cent of the line, condensed into 28-page form. Valve figure numbers are indexed for fingertip reference by topics; face to face dimensions are supplied in full size ranges.

The condensed version lists for the first time a section on bronze brazed joint valves as well as its corrosion resistant nickel-iron line. A forged and cast steel section has been developed showing complete valve trim designators and pressure temperature charts with ratings to latest ASA specs.

Valuable supplementary information is contained in a valve comparison chart which offers a quick cross reference to the most commonly used figure numbers of ten valve manufacturers.

Valve Regulators

1017

Rockwell Manufacturing Co., Pittsburgh, Pa., has published a new eight-page, photo-illustrated bulletin that describes the functions, applications and operation of Rockwell-Nordstrom valve regulators with Republic controls.

Rockwell-Nordstrom valve regulators are pneumatically controlled, cylinder operated, lubricated plug valve regulators. They are designed to provide high-pressure, large volume, gas regulation with minimum pressure loss.

Republic controls, consisting of an accurate (vector type) pressure controller and a feed-back type valve positioner, give the regulators greater regulating sensitivity.

Included in the bulletin are regulation capacity tables for the complete line (6"-16").

Insert Plastic Dall Flow Tube

1018

Builders-Providence, Inc., a division of B-I-F Industries, Inc., Providence, R. I., has published a 4-page, 2-color bulletin on the recently devel-

CONTINUED ON PAGE 109A

• Save Initial Costs
• Eliminate Costly Maintenance

thru this NEW CONCEPT in MEASURING FLOW thru PARSHALL FLUMES

with a BURGESS-MANNING TYPE "ML" METER INSTALLATION

You completely eliminate such installation costs as: excavation for dry well; concrete dry well foundation and walls; metal float well and cover; connecting telltale piping, valves and fittings between Parshall Flume and float well; float cable and protecting piping; clear water piping and fittings for back-purge system, and metal grating to cover dry well.

And, most important, the only maintenance you will have is the possible hosing off, in a few seconds, of the float once in many weeks. Receiver may be located up to 5000 feet from transmitter.

Write for Burgess-Manning "ML" Meter Bulletin.

Think of the savings! Think of the elimination of maintenance!

BURGESS-MANNING COMPANY
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4132 Haverford Ave., Philadelphia 4, Pennsylvania

1-Pc. Aluminum Guides & Stop Plates or Sluice Gates

Mean Easy Installation, Greater Economy!

The one-piece construction of our aluminum guides eliminates clumsy machine grooved or riveted flat bar assemblies. Their ease of installation and low cost (on a per foot basis, less than that of steel or other metals) are points to consider.

Strong, durable, non-corrosive qualities of Aluminum make it important to Water and Sewage. *Washington Aluminum Engineers are available for discussion of design problems on any installation at point of planning. No obligation.* Write for nearest representative.

WASHINGTON ALUMINUM COMPANY, Inc.
Dept. 710 • Baltimore 29, Md. • Phone Circle 2-1000

take it

Just what the doctor ordered—an easier day's work. That means Tyton Joint® pipe. This ingenious pipe is a cinch to lay... anywhere, any time... even by inexperienced crews.

No need for bell holes or caulking... no nuts or bolts to fasten. Simply fit a specially designed rubber gasket

U.S. cast iron PIPE

FOR WATER, SEWERAGE AND

easy!

into the bell, and slide in the connecting pipe. The gasket insures a tight, permanent seal. And you can lay Tyton Joint pipe in wet trench or rain.

Call or write for complete details as to how Tyton Joint can save you time, money, trouble.

U. S. PIPE AND FOUNDRY COMPANY
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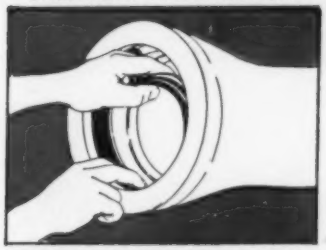
A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

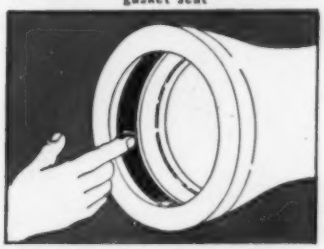
INDUSTRIAL SERVICE CAST IRON

U. S. TYTON JOINT

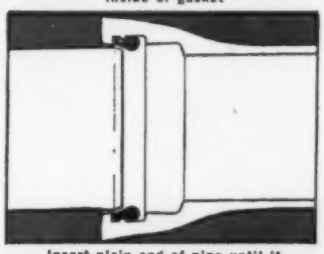
ONLY FOUR SIMPLE ACTIONS



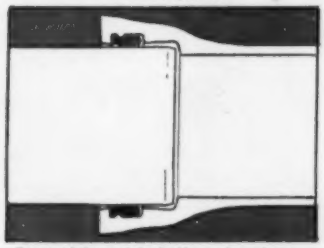
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

Tyton Joint pipe for water main extension in Oklahoma.

the right

Combination...

Design, rugged construction and operating experience are combined in just the right proportions to make Nichols Herreshoff Multiple Hearth Furnaces the most efficient and cleanest of all sewage sludge heat disposal methods.

Burn sewage sludge, grit, skimmings, screenings, or dry sewage sludge in one simple, compact furnace. No offensive smoke, odor, fly ash.

Nichols Herreshoff

Multiple Hearth Dryer - Incinerators

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70 Pine St., New York 5, N. Y.
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Section of 90″ concrete pipe is swung into place easily and quickly

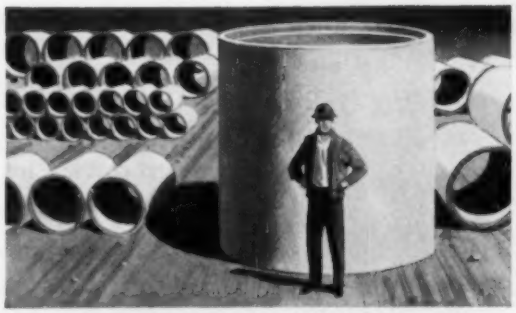
For Chicago's newest sewers . . .

concrete pipe provides maximum strength, greater capacity!

To alleviate street and basement flooding, Chicago is carrying out a multi-million dollar enlargement of its combined sewer system.

On the new Roscoe Street section, 12,500 feet of concrete pipe, 36″ through 90″ I.D., was used. Placed deep underground—an average of 27 feet for the 90″ size—the pipe carries backfill and traffic load without further support. (A real time and economy advantage, too!) And resistance of the pipe to the overburden will increase because concrete gains strength year by year.

And maximum hydraulic capacity is provided by the smooth inner surface of concrete pipe. It resists abrasive wear. Concrete sewers, too, ensure minimum infiltration and leakage. Match all this with moderate first cost and you see why concrete pipe has a long record of solving difficult sewer problems for hundreds of municipalities.



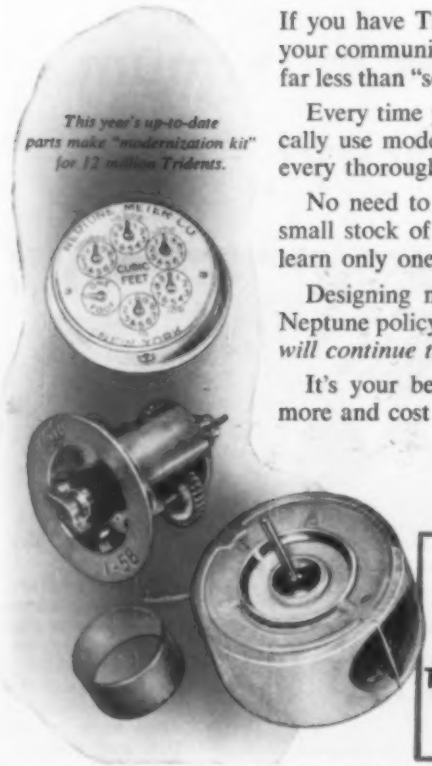
FOR ALL MODERN PIPELINES
concrete

Wide size range lets you choose concrete pipe in the size that does the job best. Write for free literature, "*Concrete Sewers*", distributed only in the U.S. and Canada.

PORTLAND CEMENT ASSOCIATION
Dept. 10-29, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of concrete

Do you have AUTOMATIC MODERNIZATION in your water system?



This year's up-to-date parts make "modernization kit" for 12 million Tridents.

If you have Trident water meters, your department is probably the only service in your community equipped with *Automatic Modernization* . . . a process which costs far less than "scrap and replace" programs.

Every time you replace work-worn parts in a Trident disc meter, you automatically use modern parts identical to those in the *latest* model . . . parts embodying every thoroughly tested advancement known to the science of metering.

No need to keep complicated stocks of parts for many models . . . just keep a small stock of modern parts. It's easier to train service men, too. Your men need learn only one simple, fool-proof model, and they can service all.

Designing modern Trident parts so they'll fit "old" meters has been a rigid Neptune policy for 60 years. *Every design improvement now on our drawing boards will continue this policy.*

It's your best assurance that the meters you buy today will continue to earn more and cost less for many decades to come.

284

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TRIDENT WATER METERS

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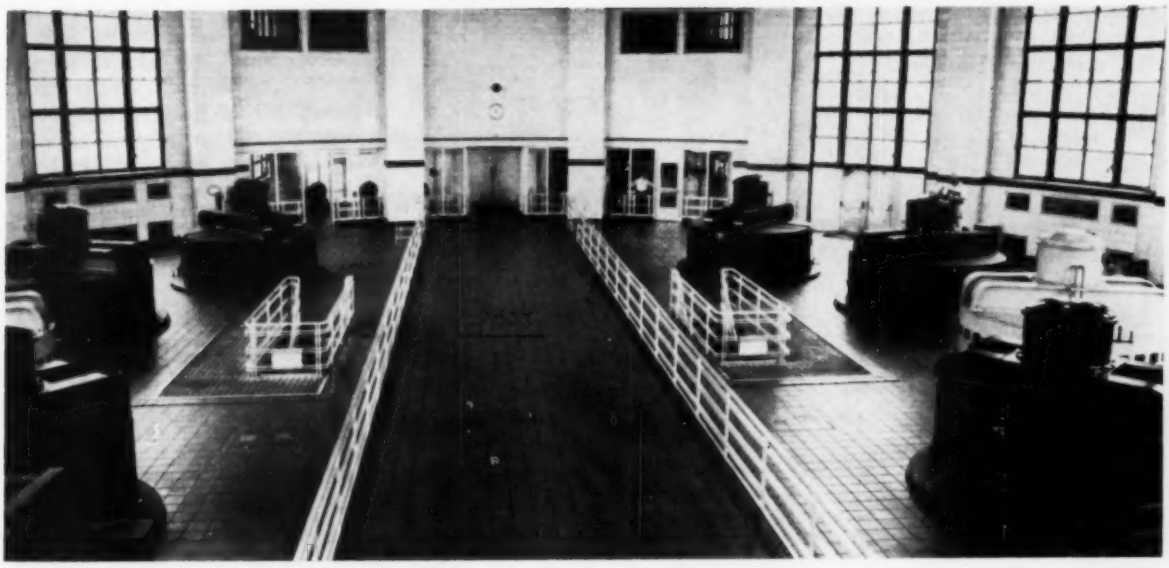
Vol. 105, No. 10 • October, 1958

WATER & SEWAGE WORKS

A Scranton Gillette Publication



MAIN FLOOR of 113-ft. diameter pumping station houses eight mixed-flow centrifugal pumps which lift sewage from 2,667,000 persons for gravity flow through . . .

Detroit's Sewage Treatment Plant

by FRED H. BURLEY
Engineer of Sewage Treatment
Department of Water Supply, Detroit, Mich.

EDITOR'S NOTE: This year the City of Detroit is host to the 31st annual convention of the Federation of Sewage and Industrial Wastes Assns. Included on the program of that meeting is an inspection trip of the Detroit Sewage Treatment Plant. In this article, Mr. Burley describes the facilities of the plant as originally designed, subsequent changes in facilities and current operation and maintenance practice. In a companion article, Gerald Remus, General Manager of the Department of Water Supply describes the long range $33 million sewage plant expansion program to serve future community needs. WATER & SEWAGE WORKS presents these two articles as a salute to the City of Detroit and the FSIWA.

■ UNTIL DETROIT opened its modern sewage treatment plant in 1940, the city disposed of its wastes by dilution in the Detroit River. When the plant opened treatment facilities were provided for 1,700,000 people in Detroit and suburbs. This was the beginning of a "good neighbor" era for communities along the Detroit River, for the river plays an important part in the area's recreation.

Not only has river recreation become more attractive, but the healthy growth of the metropolitan area was stimulated when the plant opened. Today more than 2,600,000 people in Detroit and 34 suburbs are served by this modern facility.

GRIT collectors (left) and bar racks (right) are housed in same building.

The Sewage Treatment Plant is under the management of the Board of Water Commissioners. Revenue to operate the plant is based on water consumption and is collected on water bills. No tax money is used to build or operate the facility.

Plant Facilities

The plant provides primary treatment with chlorination of the effluent and vacuum filtration and incineration of the sludge. Approximately twenty per cent of the sludge is subjected to anaerobic digestion in a single digester.

Regulators were constructed as the work on the interceptor progressed. Most regulators are of the float-actuated type and located where the Interceptor crossed under the old main sewers. These divert the dry-weather flow and a large portion of the storm flow to the interceptor for conveyance to the treatment plant. The topography of the drainage area does not permit gravity flow entirely and sewage pumping stations are necessary at several locations. Some sewage is pumped at three different stations before it reaches the plant site, while sewage from other areas flows entirely by gravity.

Pumping Station

The pump station substructure was built as a 113-ft diameter caisson sunk to bedrock. The 50-ft high superstructure is circular and joined to the 55 x 219-ft rack and grit building.

All sewage received at the plant enters the suction well and is pumped without screening to a sufficient height to flow by gravity through the entire plant and be discharged through the outfall conduit to the Detroit River.

The original installation included six mixed-flow pumps (two each of 180 cfs, 230 cfs, and 280 cfs). These are located in dry wells each side of the suction well. The motor floor is located 45 feet above the pump floor with an intermediate steady bearing floor. Motors are synchronous, 4600-volt, separately excited (800, 1000 and 1,250 hp). A set of guides is provided in the suction well at each pump suction flume. One large broom gate can be moved by monorail and air hoist to any suction flume. Each pump has a hydraulically-operated discharge gate.

During the plant expansion (1955-56) two additional 230 cfs pumps with 1000 hp motors were installed. Provisions for this expansion were made in the original construction. The present installed capacity of 1840 cfs utilizes all space provided in the structure.

Bar Racks and Grit Chambers

Each of the main pumps has its own connecting flume to a single mechanically-cleaned bar rack. The bars are spaced ¾ in. apart and are inclined in a channel approximately 14 feet deep. The cleaning rakes are attached to a drive chain and sprocket and slip in a groove provided with wear strips. Screenings are dumped by the rakes onto a conveyor, sorted to remove tin cans, large blocks of wood, etc., and are ground and returned to the incoming sewage.

After screening the sewage flows into grit chambers, each equipped with two parallel Vee-bucket conveyors. The chambers are 16 ft deep and 12 ft 10 in., 16 ft, and 19 ft 2 in. wide depending on pump size, and designed for a velocity of one foot per second. The conveyors are operated continuously or intermittently and dump the grit into flight conveyors for transporting to the end of the building.

During the plant expansion (in 1955-56) the bar racks and grit mechanisms for the two channels corresponding to the two new main pumps were installed. The original design and construction had made provision for this. Equipment similar to the units in use was purchased and was installed by the plant maintenance force.

Sedimentation Tanks

The grit channels discharge over weirs into a common outlet chamber. The flow to the sedimentation tanks is through two 10x10 ft conduits with 3x10 ft Venturi meters. Two distributing conduits beneath the pipe gallery floor are connected by 18-inch piping and 18-inch gates to the sedimentation tank inlets. Each of the eight sedimentation tanks has seven flow-through channels, 16 ft wide, 14 ft deep and 272 ft long, with two 18 in. inlet connections (aforementioned). The dividing walls between flow-through channels support a "dog leg" baffle at the inlet, flight conveyor collecting mechanisms, and a roof slab completely covering the tanks. The flight conveyors deposit the sludge in a cross-conveyor channel at the inlet end and move grease and scum to a scum cross-collector near the outlet end. A vertical baffle parallel to the scum collector prevents scum from reaching the effluent weir troughs which discharge into a collecting channel. The effective length of weir is twice the tank width.

The scum cross-collectors dump into a hopper which is washed by a continuous water spray. When the scum accumulates in a storage tank a float switch is actuated and the scum pumped to a separator in the incinerator building.

The sludge cross-collectors at the inlet end supply the sludge pumps which pump to the vacuum filter building or the digester as required.

During the plant expansion (1955-56), two new Sedimentation Tanks were constructed. A connection was made at the grit chamber outlet for

a 108-inch concrete pipe. This line runs through a Venturi meter to the new sedimentation tanks. In order to avoid settling, and to provide easy cleaning, the distributing conduit was placed above the pipe gallery. Each flow-through channel has two 4x4 ft inlet gates. The depth of the tanks was made four feet less than the original tanks to avoid an unfavorable soil condition. It was expected that the shallower depth would not adversely affect suspended solids removal. In all other respects the two new tanks are very similar to the original one.

Sludge Digester

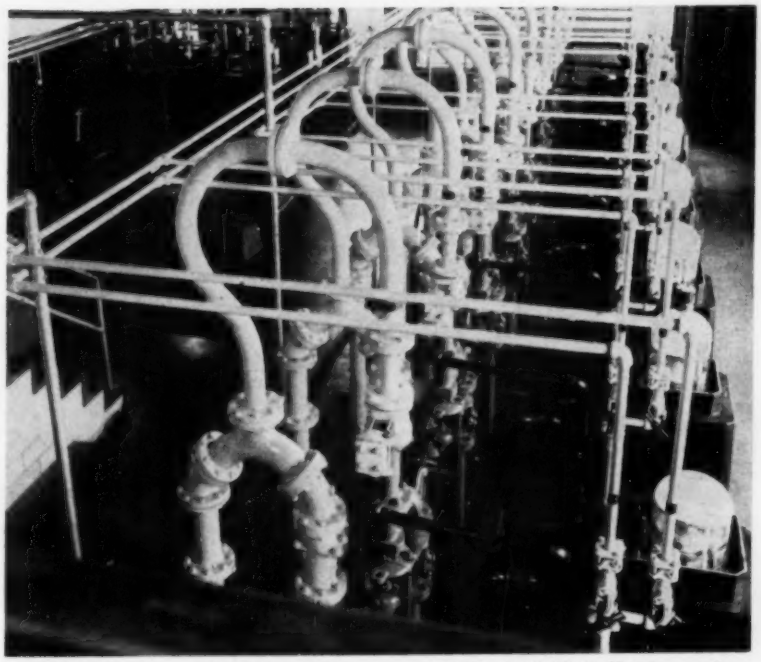
The single floating cover Digester is 105 ft in diameter and has a 300,000 cu ft capacity. It is heated by hot water coils mounted in side-wall brackets. Sludge may be added to or drawn out of the tank at four side or four center locations.

Gas accumulated under the cover at approximately 8 in. (water col.) pressure is metered by a ring balance device, and flows through the low pressure system to the gas engine generator, or is compressed to approximately 6 psig and utilized in the boiler room for plant heating. For the past several years, a gas odorizing agent has been added. The detection afforded has prevented dangerous accumulations of gas on at least three occasions.

Sludge Filter Building

Vacuum filters are used to reduce the moisture content of the sludge prior to incineration. The filter building is 60 ft wide and 250 ft long. The original construction provided emplacements for twelve 500-sq ft filters of which eight were installed as original equipment.

Sludge is delivered to sumps located in the center of the building. Bucket elevators discharge the sludge into mixing tanks where lime and ferric chloride are added as conditioning agents. The conditioned sludge flows by gravity to the filter pans. The filters revolving in the pans with vacuum applied pick up the sludge, partially dewater it, and with vacuum disconnected and a slight air blow discharge the sludge filter cake onto conveyor belts running the length of the building to the adjoining incinerator building. Vacuum is applied to the filter drums and the filtrate drain system by three vacuum producers, (reciprocating machines with much of the appearance of an air compressor), rated at 3780 cfm each, equipped with 150 hp induction motors. Compressed air at 3 psig is furnished by centrifugal blowers direct-connected to 15 hp motors.



NINE vacuum type chlorinators have a capacity of 6000 lb/24 hr each and are housed in room with nine evaporators which can supply one or two chlorinators. 6,000,000 lb of chlorine are used each year.

The filtering medium is 10-oz. Canton flannel with medium length nap. Other media have been tried with various degrees of success, however the Canton flannel has proven the most economical. Cloth life is usually between 300 and 350 hours. New cloths are attached to the drums by sash cord in alternate dividing strips and No. 12 bright basic steel wire.

During the plant expansion (1955-56) four additional vacuum filters were installed in the locations provided in the original construction. These are very similar to the original eight filters. The use of plastic drain boards instead of wooden deck supports and Monel screens is the most conspicuous difference.

Incinerator Building

A building 75 x 211 feet in plan and six stories high contains incinerators, conveyors, ash pumps, air compressors and miscellaneous equipment.

The sludge filter cake, grit and sedimentation tank scum is burned to a sterile, inert ash in multiple-hearth incinerators. There are four such units of which three are in operation.

Filter cake and grit are discharged onto the conveyor system in the basement of the incinerator building, pass over a weightometer, and after a number of transfers reach the distributing conveyor above the incinerators. A system of splitters and plows divides the load between the incinerators. The incinerator has an air-cooled central shaft with rabble arms at each of the eleven hearths. Movement across the hearth is accomplished by plow-like teeth attached to the under side of the arms. The direction is toward a number of drop-holes near to exterior shell on "out" discharge hearths, and toward a single large circular drop-hole around the central shaft on "in" discharge hearths.

The upper hearths dry the materials by contact with the hot gases from the hearths below. After sufficient drying, the materials ignite in the combustion zone comprised of the intermediate hearths. Cooling of the ash takes place on the lowest hearths and the ash is discharged from the bottom of the incinerator into a hopper with quenchers for cooling. The ash hopper is opened hourly and con-

THREE of twelve vacuum filters, each with a filtering surface of 500 sq ft. More than 90,000 tons of dry solids were filtered last year.

tents jetted into a sluicing trench which leads to an ash sump. The ash-water mixture is pumped to lagoons at the rear of the plant site.

The hot gases from the incinerators pass through a breeching equipped with dampers and up ten foot-diameter stacks to discharge 124 feet above ground level.

In order to attain good operation, increase capacity, and minimize maintenance, many improvements have been made over a period of years. The more important are described briefly as follows:

(1) Screw feeders to replace the original sliding gate feeders.

(2) The use of two screw feeders per incinerator: one is located to obtain maximum distribution over the top hearth; the other is located so the materials will pass through drop-holes and a by-pass drop-hole to the upper combustion zone. This has the effect of lengthening the combustion zone and increasing capacity without overheating.

(3) Larger breechings were installed to provide adequate draft and sufficient excess air. The top hearth was sacrificed to provide sufficient height for the new hot gas exits. This made the new top hearth an "out" hearth and reduced the number of hearths per incinerator from twelve to eleven. The dampers were made by placing refractory brick walls on two motor-operated turntables at each breeching.

Hearths previously constructed of refractory blocks were replaced by cast-in-place refractory poured very dry in alternate segments. Drop-holes of larger area than original were formed out with reusable steel froms.

Rabble arms of nickel-chrome alloy were insulated and used in the hotter hearths. Rabble teeth of "25-12" chrome-nickel alloy have given excellent service and wear thin before buckling or cracking.

The central shafts are insulated and reinforced with Ni-chrome wire. Insulation is promptly repaired without cooling the incinerator by use of castable refractory and a compressed air refractory "gun."

Corrosion of the steel shells was evidently caused by hot gases containing small quantities of sulphur dioxide gas entering cracks in the refractories and reaching the interior face of the shell between hearths (where insulated by loosely placed blocks). To provide adequate structural strength, 6 x 6 x ⅜ in. steel angles were placed vertically between hearth butt straps.

Chlorination Building

Approximately 6,000,000 pounds of liquid chlorine are delivered in 30-ton railway tank-cars annually for disinfecting the effluent. Chlorination is practiced the entire year. A siding permits the "spotting" of three cars just outside the chlorination building. The liquid chlorine is piped into the building and evaporated in steel cylinders immersed in circulating hot water. The gaseous chlorine is piped through a regulator and to the vacuum chlorinators, which meter the chlorine at set rates for mixing with potable water to form a strong chlorine solution. There are nine evaporators, each of which can supply one or two of the nine vacuum chlorinators which have a 6000 lb/24 hr rated capacity each. The chlorine solution flows through rubber-lined pipe to a diffuser located in the junction shaft. This shaft provides adequate submergence as it conveys the sewage from the sedimentation tank outlet conduit vertically downward to the outfall tunnel. This tunnel is 18 ft in diameter and six thousand feet long, affording adequate contact time at all flow rates. The outfall conduit ends at an 18-foot-diameter, 90° concrete ell which discharges into the Detroit River four hundred feet from the harbor line in forty-foot depth of water.

The chlorination building is a wing of the administration building but is so constructed that it is necessary to go outdoors between buildings. The original equipment included a large exhaust fan with caustic soda spray for neutralizing chlorine fumes in case of a break. This can be operated by a switch located outside the building.

Above each evaporator is a frangible silver disc which will break in case of excessive pressure. The vent piping originally led to the outside atmosphere. This was revised so the piping now leads to the plenum chamber of the fan, permitting neutralization of fumes should a frangible disc break.

The original equipment included a "telltale" cylinder mounted on a scale, the beam of which would tip in case a car became exhausted and the liquid contents of the "telltale" cylinder depleted. This frequently gave false alarms due to the cylinder being evacuated during normal high-rate chlorination. A low pressure gauge with alarm has been substituted. High pressure alarms have been installed on all evaporator cylinders and set at

ASH from incineration of solids is sluiced to one of two lagoons with a total area of 7.6 acres within dikes 9 ft high. Drained ash is removed by independent contractors.

an adjustable, predetermined pressure. These sound an alarm and actuate a light at the individual evaporator.

Low and high temperature alarms on the evaporator circulating water are in service as originally installed.

Miscellaneous

The Laboratory, with kitchen, supply room and supervising sanitary chemist's office, is located on the second floor of the administration building, connected to the chlorination building by an outdoor balcony. It is completely equipped for a wide range of activity.

The plant site comprises 72 acres located in a heavy industry area. Good road and rail facilities are provided. The greater part of the site is landscaped with trees, shrubs and lawns. The lawns require seeding, reseeding, rolling, and application of weed-killer and fertilizer by the yard maintenance crew. Eradication of ragweed is provided by another City Department as part of a city-wide program.

Two ash lagoons enclose an area of 7.6 acres within earth dikes nine feet high.

The boiler room is equipped with two 200 hp and one 50 hp boilers. During winter one of the former, fired with digester gas supplemented by fuel oil, furnishes steam for space heating, digester circulating water, chlorine evaporation, fuel oil heating, washrooms, etc. During summer the boiler room is shut down and hot water heaters are used for chlorine evaporation and wash-rooms. Heat for the digester is salvaged from the operation of the 6-cylinder, 350 hp gas engine operating a 240 kva induction generator.

The extensive piping system for utilization of digester gas and the possibility of accumulations of gas from sewage make safety precautions necessary. Three major safeguards are: ventilation, odorization of digester gas, and combustible gas detectors. Portable gas detectors are used before men enter confined locations to work, before cutting or welding is done in a building where there is possibility of gas accumulation, and at twenty-four locations throughout the plant on a routine basis. Constant sampling stationary gas detectors with alarms are provided in the suction well, main pump pits, and digester control room.

The switch house has transformers installed in a bay open to the outside air on one side. There are two separate power lines from the Public Lighting Commission: one is directly from the generating plant, and the other is from a sub-station with Detroit Edison Company stand-by. Current is received at 24,000 volts and reduced to 4800 by two 10,000 kva primary transformers which supply the main pumps and the two secondary transformers. The secondary transformers supply 460-volt current for the plant processing equipment and the lighting transformers. Motor generators and wet storage batteries supply the direct current control circuits and the emergency lighting.

Operation and Maintenance

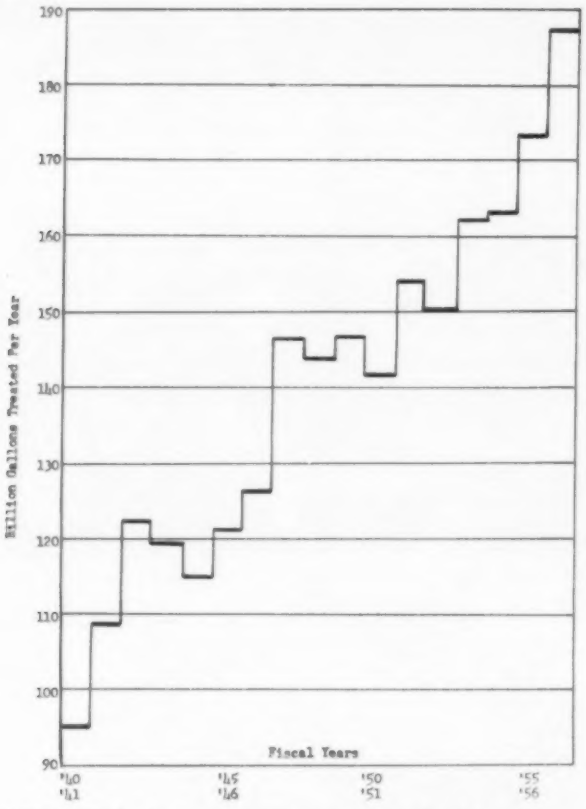
The increased loading on the plant is indicated as follows: For the fiscal year July 1, 1940 to June 30, 1941, average pumpage was 261 mgd for an estimated contributory population of 1,700,000; for the fiscal year July 1, 1956 to June 30, 1957, average pumpage was 513 mgd for an estimated contributory population of 2,628,000 in Detroit and thirty-five suburban communities.

Pumping

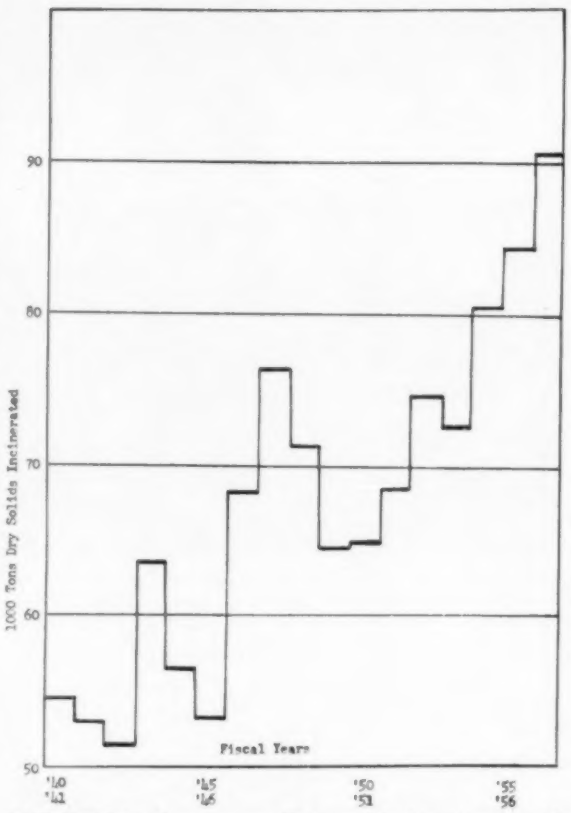
Electrical energy requirement for pumping, processing and lighting averages 73,800 kwh per day. Nearly all is purchased from the City's Public Lighting Commission at a fixed rate subject to annual adjustment. About one per cent is generated at the plant by an induction generator driven by a gas engine.

During eighteen years of operation there has never been a power interruption of more than a few seconds' durations.

Pumps are manually started and stopped in the constantly attended control room. The elevation in the suction well is maintained within two-foot limits the greater part of the time.



INCREASED load on sewage treatment plant is evident from these data for the past 17 years.



INCREASED load on vacuum filters and incinerators roughly parallels the volume of sewage treated.

These limits are selected to prevent spillage to the Detroit River at the regulators and to minimize the lift, thereby conserving electrical power. Each night shift, the level is pumped four feet below normal and once a week (weather permitting) the level is pumped down until the pump suctions draw air in order to scour the interceptor.

Repairs to the oil system, replacement of leather packing, and replacement of steel wear rings comprise the major maintenance. Motors are cleaned annually.

Grit Removal

A Grit Storage Bin is used to minimize the effects of peak loads before sending grit to the incinerators. Loads of over 200 tons per day occur during storms. Average loads of 30 tons per day are usual during dry weather.

It has been found good operating practice to flush heavy accumulations of grit out of the connecting flumes and grit chambers. To obtain prompt drainage, additional 12-inch drain valves have been installed near the bar racks.

The heavy maintenance work is usually scheduled for winter months when the flow is less than average. The major annual items are replacement of bar rack and flight conveyor wear strips; replacement of sprockets; straightening and rewelding bars on bar racks; replacement of wear shoes on grit collectors and conveyor flights; removal and replacement of bushings and pins in conveyor chains; straightening and replacement of rake teeth. The wear rails in the grit chambers require replacement at approximately six-year intervals.

Sedimentation and Sludge Removal

Normally the sludge pump operates a few minutes per hour on automatic pumping. The pumps are operated manually such additional time as needed to keep up with the accumulation of sludge, or to maintain the processing rate in the Filter Building. Cleaning of pumps is sometimes required several times a shift, to remove sand, sticks, rags, etc.

There was practically no difficulty with plugged sludge lines during the first fifteen years of operation. Recently this has become a repeated source of difficulty. Blow-offs for cleaning sludge lines have been installed at four locations in the last two years. Cleaning is usually accomplished by running warm supernatant through the lines to loosen the greasy, gelatinous deposits.

During normal operation the flights in the flow-through channels are operated alternate hours (even-numbered one hour, and odd-numbered the next hour). During storms the heavy, sandy sludge accumulates too fast for immediate removal and the flight conveyor in one flow-through channel per tank is operated. When the sludge thickens to fourteen or sixteen per cent solids, some draining of the cross-collector channel is usually necessary, to prevent breakage or excessive shear pin replacement. During periods of high storm flow brass pins may shear as frequently as twenty times a day.

The distributing conduit is subject to deposition of fine sand and requires occasional cleaning.

Minor overhaul of the sludge-collecting equipment is scheduled annually in each sedimentation tank. This usually includes replacing many wear shoes, sprockets, adjusting conveyor and drive chains, etc. A major overhaul is required after a sludge collector has been in use about seven years. The chain is reversed (turned upside down), flight carier links replaced or reversed, new carrier shoes and wear strips installed, and sprockets replaced. Four to five years' additional chain life is realized from this procedure. The redwood flights show no decay but sometimes require replacement due to mechanical breakage. Of the original 3,024 main flights, approximately 1,600 have been replaced to date.

Sludge Digestion

It is usual to add sludge to the digester and make draw-offs of supernatant hourly. This suffers some interruption when sludge lines are being cleaned with supernatant or when the scum layer is being removed. The normal feed rate is 40 tons of sewage solids (dry basis) per day, with a limitation of 120,000 gallons which is the maximum the coils can heat in winter. The feed usually contains approximately 24 tons volatile matter per day, about three-eights of which is either digested or separated into the scum layer. During winter approximately ten million cubic feet of gas is metered and utilized in the boiler room per month. Feed rate is reduced during other seasons.

The digester heat exchange declines seriously in the course of two years' operation and the tank is taken out of service to clean the coils and remove heavy, gritty sludge from the bottom cone. "Seed" sludge (approximately 30 tons) is stored and added after the digester has been refilled with sewage. Additions of fresh sludge are then made at a daily rate equal to one-fifteenth of the cumulative solids inventory. This has proven a very successful schedule for restarting.

Vacuum Filtration

During periods of difficult filtration mixed raw and digested sludge frequently filters better than either processed separately. The nature of the sludge has changed with the years and production rates are increasingly difficult to maintain. During the past eleven years the annual average filter yield has declined from 7.0 to 3.4 pounds dry sewage solids per square foot per hour. During the past ten years the average of the poorest month during the year has declined from 4.0 to 2.5 lb dss/sq ft/hr. Increasing the frequency of washing, adjusting chemicals, providing additional fresh cloths, and other operational expendients have failed to reverse this trend. Filters are normally washed once or twice each shift.

During the early 1950's as much as 20 per cent of the annual average filter production was obtainable by conditioning with lime alone, no ferric chloride being required. During the fiscal year 1956-57 it was possible to filter only 3.8 per cent of the total production with lime alone.

The ferric chloride dosage has increased from 0.70 per cent during the fiscal year 1952-53 to 1.17 per cent during the fiscal year 1956-57. The winter months of 1958 show a sharp increase to over 2 per cent ferric chloride dosage. This has been accompanied by poor sludge pump delivery, more frequent cleaning of sludge lines, filter "blinding" and poor filter yield. These adverse conditions are being combated by varying operational procedures, laboratory studies, and trade waste surveys.

The chemicals used for sludge conditioning are lime and ferric chloride. The original layout of the chemical room provided for pebble lime to be unloaded from railway cars and stored in four 60-ton cylindrical bins with conical bottoms. Lime feeders and slakers located directly beneath the storage tanks produced a milk of lime solution which flowed to the sludge conditioners. This system is retained as a stand-by with two 60-ton storage bins for pebble lime.

The large part of the lime used for the past twelve years has been waste lime slurry purchased from the local acetylene plants and hauled by the Division's tractor and four thousand-gallon trailer tank. Slurry is screened, to remove clinkers and other solid material, and pumped to two of the cylindrical bins which have been converted to twelve thousand-gallon liquid storage tanks. Agitation is provided by compressed air hoses which are weighted and suspended from the tops of the tanks. Flow is by gravity to the sludge conditioners. At the conditioner a simple type of plant-made valve is actuated by the bucket elevator drive mechanism. This material has proven an economical substitute for pebble lime.

Ferric chlorine is delivered in aqueous solution by railway tank-cars. It is unloaded by compressed air into ten thousand-gallon storage tanks in the chemical room basement. It is pumped with simultaneous dilution to a small auxiliary tank above the main floor of the chemical building. The flow is then by gravity to the proportioning devices at the sludge conditioners.

Ferrous sulphate was used to condition 60,000 tons sewage solids (dry basis) on plant-scale experiments run in parallel with ferric chloride from October, 1949 to June, 1953. The source was spent pickle liquor from descaling steel. It was found a very weak coagulant in comparison to ferric chloride, required more lime due to the presence of unspent sulphuric acid, and gave much lower filter yields. Addition of chlorine to make chlorinated copperas provided a conditioning agent comparable to ferric chloride. However, no reasonable margin of profit could be found that would make it supersede ferric chloride.

Lubricated full-area rectangular port plug valves have been used to replace approximately fifty per cent of the original gate valves. Accumulations of lime scale frequently prevented closing of gate valves.

Major maintenance work in the filter building is noted below, with the usual interval shown in parentheses:

Acid cleaning of filter piping, decks and screens (6 months).
Replace deck support strips (3 years).
Replace maple dividing strips (3 years).
Remove, machine and replace bronze valve heads (5 years).
Replace redwood decking (approx. 18 years). Three filters have been redecked in the past two years. Deterioration occurs where end grain can be penetrated by muriatic acid solution.
Repaint filter interior, main shaft (10 years).
Vaccum produced valves, regrind and clean (monthly).
Vacuum produced bearings, check and adjust (monthly).
Vacuum producer 150 hp induction motor, replace bearings (3 years).
Filtrate piping, clean with rotodrill and/or treat with muriatic acid (yearly).
Bucket elevators, rebuild (2 years).
Sludge cake belt conveyors, replace (60,000 hours' operation).
Routine preventive maintenance is also carried out on all motors, speed reducers, and valves.

Incineration

A wide range of loading is possible with careful attention and no sudden changes. The low range is approximately 5 tons wet feed per hour per incinerator; and the high, approximately 14½. At the higher loadings the volatile content of the sludge is usually low due to "storm water sludge" and the large amount of grit accompanying storm water. At moderate loadings the fly-ash emission rate is within reason; however, at high loading fly-ash is a problem. The same incinerators, as long as serviceable, are run year in and year out to avoid the damage that would be caused by cooling down and reheating.

A stack temperature in the 1100 to 1200°F range is desired to avoid odor nuisance. Combustion is controlled by admitting air to the incinerators through doors and lance holes (located to afford access and cleaning of "out" drop-holes), regulating feed to obtain maximum uniformity and operating oil burners when necessary to attain suitable temperatures. An abundant supply of air is necessary to prevent slagging. Slagging causes plugging of drop-holes, breaking of rabble arms and teeth, and damage to refractories during removal. Frequently there is 100% excess air, as indicated by stack gas analysis.

Grease was originally thickened and dumped on the conveyor belt. It is now thickened and pumped to hearth #6 or #8 of the incinerator. This prevents high flash temperatures experienced wtih the original method, and often serves as auxiliary fuel instead of using oil.

Weightometer readings are now transmitted to the filter and incinerator operating post so the operators are promptly apprised of changes in grit or total feed rates.

Fuel oil of No. 4 grade is now stored for summer use in the incinerators. This grade can be moved promptly through the pipe system and ignited. The No. 6 grade was difficult to use when the boiler room was out of service and there was no adequate heating.

During the early years of operation the incinerators were run approximately three years between major overhauls. With improved operation, design, and selection of materials, the incinerators are capable of over six years' steady run. Some breaking of cast hearths has occurred without damage to rabble arms and without interference with continued operation.

The maintenance on the incinerators proper is light and fairly infrequent, consisting of replacing rabble teeth, repairing insulation on rabble arms and central shafts, freeing up and repairing dampers, etc.

All rubber belting now in use is Neoprene, which proves resistant to grease in the sludge cake. Vulcanizing of belts is accomplished in place by the plant personnel.

Major maintenance of the ash sump pumps occurs annually due to the hard service and abrasive materials.

There are two ash lagoons which are filled and excavated alternately. The surplus water from the sluicing operation runs to outlet structures which drain to the interceptor. When a lagoon is filled it is set to drain for a few weeks, then surveyed to estimate the cubic contents. A contract is let for removing and disposing of the ash.

Laboratory

The laboratory staff is responsible for sampling; performing tests for plant control and records; setting chlorinators; detection of trade wastes in influent; bacteriological analysis to determine quality of final effluent; sanitary surveys of the Detroit and Rouge Rivers; environmental sanitation within the plant; boiler water analysis and treatment; maintenance of gas masks and inhalators; First Aid treatment of employees; analysis of purchased materials and supplies, such as lime, ferric chloride, muriatic acid, fuel oil, lubricating oils and greases, etc.

The laboratory also carries out research on special assignments such as effect of chlorine dosage on bacterial kill; comparison of analytical methods for BOD, chlorine residual, etc.; determination of effectiveness of pilot-plant operation (1 mgd chemical precipitation plant, etc.), analysis of flue gas; determination of particle-size distribution of fly-ash; composition and possible use of incinerator-ash; etc.

The laboratory is constantly attended and chlorination is adjusted hourly according to demand, also each time the main pumps are changed. A test is made for "slugs" of trade waste at the time chlorine demand is determined. Should a very high demand appear due to trade waste, the chlorination is continued at a normal demand and the influent again tested at 15-minute intervals until normal demands are observed. All "slugs" of trade waste are recorded. Analysis of a composite sample is also made for ferrous iron, cyanide and phenols, and reported monthly. Due to the activities of the Dept, of Public Works and the Dept. of Bldgs. and Safety Engineering, the amount of trade waste has greatly decreased during the past ten years.

Annual Reports Recently Published

Little Rock Municipal Water Works, Little Rock, Ark. (22nd, for the period ending Dec. 31, 1957) Manager-Engineer: L. A. Jackson

Department of Public Works, City of New York (1947-1957, Ten-year Construction Progress) Commissioner: F. H. Zurmuhlen

Cincinnati Metropolitan Area, Cincinnati, Ohio (8th, Sewage Disposal Program) Engineer: A. D. Caster

Department of Public Service, Division of Water, Toledo, Ohio (Fiscal year ending Dec. 31, 1957) Commissioner: S. J. Wittenberg

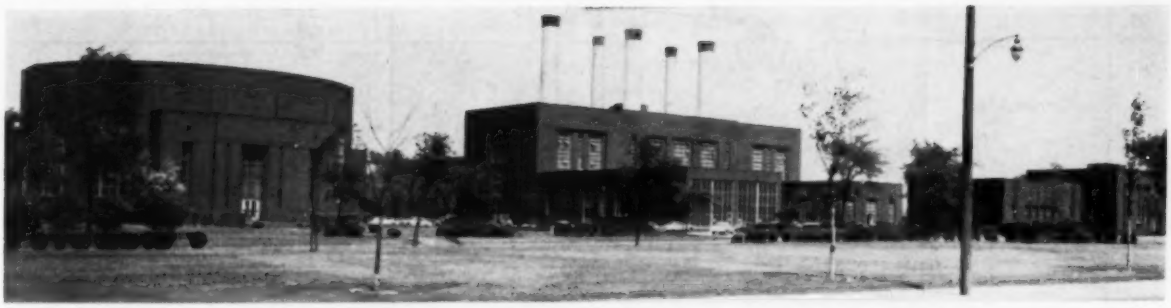
Indianapolis Water Company, Indianapolis, Ind. (Stockholders report) Chief Engineer: L. S. Finch; Operations: M. P. Crabill.

Sewage Disposal Plant and System, Racine, Wis. (20th, Year ending Dec. 31, 1957) Superintendent: T. T. Hay

Erie County Water Authority, Buffalo, New York (Progress Report) Executive Engineer: H. M. Huy

Sanitation Authority, City of Alexandria, Virginia (Toward a Cleaner Potomac River, Year ending Sept. 30, 1957) Engineer-Director: J. J. Corbalis Jr.

Portland Water District, Portland, Maine (51st, Year ending Dec. 31, 1957) Chief Engineer: W. D. Monie, Superintendent: J. P. Hennings.



DETROIT sewage treatment plant is scheduled for expansion as the city takes initiative in . . .

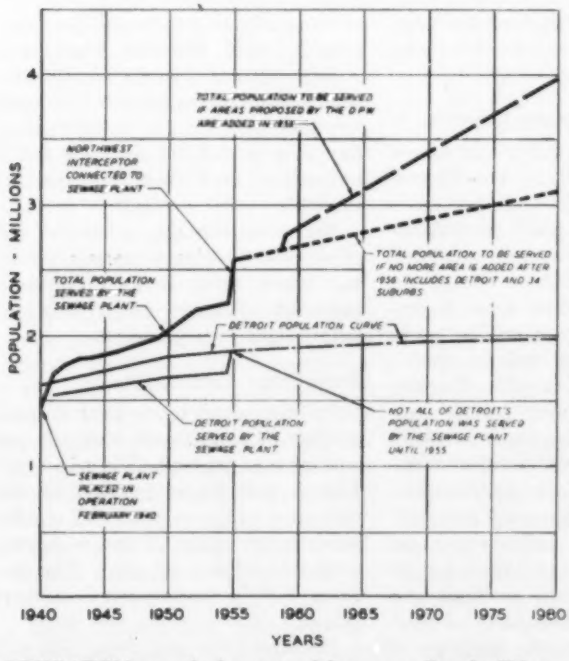
Building for Tomorrow *at Detroit, Mich.*

by GERALD REMUS, General Manager
Department of Water Supply, Detroit, Mich.

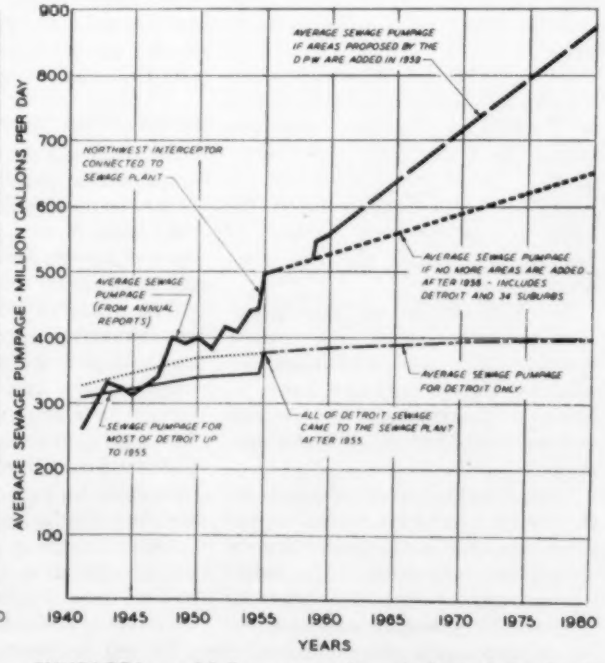
EDITOR'S NOTE: In the previous article in this issue Fred Burley, Engineer of Sewage Treatment in Detroit described the present plant facilities and their operation. In this article, Mr. Remus explains both the need and the program for expansion of those facilities to serve the growing metropolitan area of Detroit. This is one city which believes and practices the good neighbor policy for the benefit of its surrounding suburban areas.

■ WHEN DETROIT opened its modern sewage treatment plant in 1940, treatment facilities were provided for 1,700,000 people in Detroit and suburbs. Since Detroit began treating its "used water" by modern methods the entire metropolitan area has been stimulated, and today, more than 2,667,000 people in Detroit and 34 suburbs are served by this modern facility.

Other American cities, which are experiencing increasing population growth, will appreciate the magnitude of the job Detroit has successfully handled. But the task of providing adequate sanitation service for this large and growing metropolitan community is not completed and probably will never be fully accomplished as


POPULATION - MILLIONS
YEARS
1940
1945
1950
1955
1960
1965
1970
1975
1980
TOTAL POPULATION TO BE SERVED IF AREAS PROPOSED BY THE D.P.W. ARE ADDED IN 1958
NORTHWEST INTERCEPTOR CONNECTED TO SEWAGE PLANT
TOTAL POPULATION TO BE SERVED IF NO MORE AREA IS ADDED AFTER 1958. INCLUDES DETROIT AND 34 SUBURBS
TOTAL POPULATION SERVED BY THE SEWAGE PLANT
DETROIT POPULATION CURVE
DETROIT POPULATION SERVED BY THE SEWAGE PLANT
NOT ALL OF DETROIT'S POPULATION WAS SERVED BY THE SEWAGE PLANT UNTIL 1955
SEWAGE PLANT PLACED IN OPERATION FEBRUARY 1940

POPULATION growth shows need for expanding facilities.


AVERAGE SEWAGE PUMPAGE - MILLION GALLONS PER DAY
YEARS
1940
1945
1950
1955
1960
1965
1970
1975
1980
AVERAGE SEWAGE PUMPAGE IF AREAS PROPOSED BY THE D.P.W. ARE ADDED IN 1958
NORTHWEST INTERCEPTOR CONNECTED TO SEWAGE PLANT
AVERAGE SEWAGE PUMPAGE (FROM ANNUAL REPORTS)
AVERAGE SEWAGE PUMPAGE IF NO MORE AREAS ARE ADDED AFTER 1958 - INCLUDES DETROIT AND 34 SUBURBS
AVERAGE SEWAGE PUMPAGE FOR DETROIT ONLY
SEWAGE PUMPAGE FOR MOST OF DETROIT UP TO 1955
ALL OF DETROIT SEWAGE CAME TO THE SEWAGE PLANT AFTER 1955

PUMPAGE in mgd follows general trend of population load.

METROPOLITAN sewage service is an area-wide problem—cross hatched area is present service to 2,667,000. Shaded area represents additional future service to a total of 4,000,000 persons.

long as urban population continues to boom as it has thus far in the twentieth century.

Detroit's Sewage Treatment Plant is under the management of the Board of Water Commissioners, who also operate the municipally owned water works. Under the direction of the Board of Water Commissioners, the future sewage treatment demands of metropolitan Detroit are now being studied.

A $33,000,000 sewage plant expansion program, which will extend through 1975, was announced last May by Detroit's Mayor Louis C. Miriani. The expanded service area will eventually include 4,000,000 people.

Since World War II, demands on the sewage plant have multiplied and it now operates near capacity. Several factors are responsible: (1) industrial growth has increased industrial wastes; (2) Rising standards of living require higher per capita use of water; (3) More and more domestic and commercial garbage grinders are being used—this has increased the "bulk" the plant must process; and (4) Population is booming.

Growth versus Treatment Capacity

Metropolitan sanitation service is an area-wide problem. The Detroit expansion program is based on a philosophy of reciprocal responsibility and benefits between Detroit and the suburbs.

The Board of Water Commissioners which operates Detroit's water and sewage utilities believes that a single agency can provide the best service for a large metropolitan area. The metropolitan approach for both water and sewage service offers many economies to both the municipalties and the individual customers involved.

Only through a single system can the savings of a large operation be realized and duplicate facilities and overlapping authorities be eliminated.

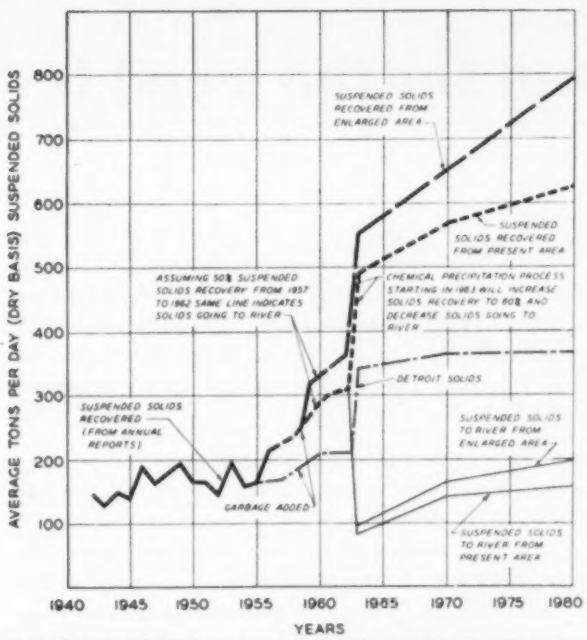
Detroit has taken the initiative in planning for the needs of the metropolitan community. Many suburban communities in the Detroit area desperately need adequate sewers and sewage disposal systems to make possible their further growth. In some newly developed areas, home building has been prohibited by state health authorities until these facilities are available.

Before state health authorities will allow new building in certain suburban areas, these communities must construct adequate sewer networks within their own jurisdiction.

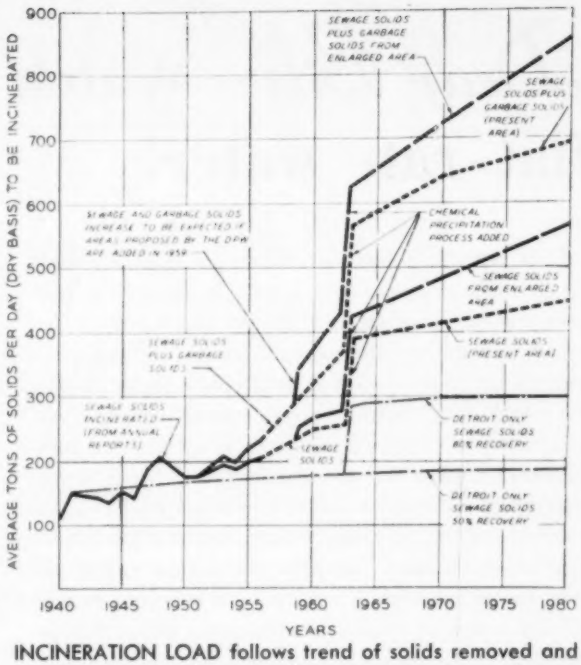
Three-Stage Building Plan

At the same time, Detroit must enlarge its capacity to transport and treat greater amounts of "used water." Detroit will begin its part of this reciprocal program in the fall of 1958 when construction of larger sewage disposal facilities will start. The program will be accomplished in three stages.

Between 1958 and 1961, $20 million will be invested to enlarge the



SUSPENDED SOLIDS removed by sedimentation is affected by both population growth and process changes proposed for 1963.



INCINERATION LOAD follows trend of solids removed and shows effect of garbage loading as well as proposed process changes.

treatment plant. Additions to the plant will include sedimentation tanks, a new filter building and additional vacuum filters, and an incinerator building and equipment. At the same time, improvements and extensions will be made to Detroit's interceptor sewers so that waste from neighboring communities can be accepted from their sewer systems.

An important "good citizen" feature of the program will be the removal of an air pollution problem at the treatment plant. A device will be installed on the incinerators to prevent "fly ash" from discharging to the atmosphere. For a long time the Board of Water Commissioners has wanted to eliminate this problem, but until the current program was approved, money was not available.

From 1961 to 1965, more new buildings and equipment will be built to handle the higher load of waste material the plant will have to process. Over $5.7 million will be spent on improvements in this period. New equipment will be in use by 1966 that will improve the process and give much better control over sewage treatment.

From 1965 to 1975, $7 million will be spent to complete expansion of the plant.

Both Detroit and suburban customers will benefit from the sewage expansion program. Expanded facilities will insure better community health, promote further development of surban areas, and provide the improved service customers are demanding.

Rising prices and the rapid increase in the use of garbage grinders since World War II have added to the cost of operating the sewage treatment plant. Garbage grinders add considerable bulk to the "used water" and this bulk is expensive to process. More chemicals and more equipment are required to do the job.

All indications are that more and more garbage grinders will come into use. Since January 1, 1956, Detroit has had an ordinance requiring installation of food waste disposal equipment in every new home, in many types of remodeled dwellings, and in commercial establishments where food is processed. In some new suburban areas, most of the homes have garbage disposal units.

Rate Increase Will Pay for Expansion

Up to now, customers have not been charged for the added expense of removing ground garbage. In effect, many people have been getting an expensive extra service at no extra cost to themselves.

A small adjustment in the sewage rate to meet the cost of providing service will become effective January 1, 1959. The sewage rate, which is paid as part of the water bill, is based on water consumption. The rate increase will be ten cents per 1,000 cubic feet of water used. Most families use about 1,000 cubic feet of water a month, so the increase will cost the average householder only ten cents monthly.

The rate increase is slight because both Detroit and suburban customers will share the cost (and the benefits) of the expansion program.

The last increase in Detroit sewage rates was made in 1949. Tax money is not used to build or operate the sewage disposal system. This sanitation service is completely self-supporting and is paid for by the sewage rate. Suburban communities, of course, will independently arrange the financing for their parts of the program.

A Single Utility

Detroit is now in the process of negotiating contracts to provide sanitation service to all principal population centers and communities in Wayne, Oakland and Macomb Counties.

This program to expand sewage treatment facilities will in effect create a single public utility which is capable of providing sanitation treatment for the entire metropolitan area.

Dear Bill: Watch out for the trend to flat-rate water!

It is interesting how one will begin to take things for granted. For example, I thought everything had been written about the folly of flat rate schedules for water use that everyone was in agreement the only way charges for water-use could be properly allocated was by actual measurement through meters and that no plant could be efficiently operated if not 100 per cent metered. I think that thought is correct but it seems that unfortunately some people just do not read, or have recently entered the water supply business and forgetting it is a business, search for the popular expedient. And to the uneducated user, to have delivered to him all the water he wants, whether used or wasted, is popular!

The thing that has brought all of this to mind is it has recently come to my attention that the commissioners of a water supply in a very enterprising community were considering abandoning meters (they are 100 per cent metered) and going back to the horse and buggy days by instituting a flat rate schedule. So I decided to unburden myself by writing, knowing that you do not need this lecture, but just to relieve myself to a sympathetic ear.

Meters accurately record the amount of water your customers use. They pay only for this amount. They pay you at a fair rate established by your utility to cover their proportionate share of the cost of gathering the water and delivering it to their homes. On a flat rate system the small user is being discriminated against in favor of those using greater quantities billed at the same rate. Discrimination is a sin no utility should tolerate.

Meters discourage waste. Wasted water is an expensive luxury in any community. With all the raised voices we are hearing today shouting the need of more and more water those water utilities that are not 100 per cent metered should take note and get busy. With a meter standing guard over each service, water waste is discouraged. Everyone benefits by having an assured supply of water for every need.

One point that is often overlooked or not given sufficient weight is that without meters the manager never knows anything about the efficiency of his distribution system. How much water that is pumped is actually being delivered to the customers? Yes, where flat rates are in effect they make "estimates" but to use that term flatters the figure, for it is just a guess and making guesses only fools the manager. Under such conditions reducing water losses has little chance of success. With meters if the utility does not bill at least for 85 per cent of the water pumped, the manager knows he should get busy.

Unfortunately there are too many that feel that if they are 100 per cent metered the job is done and they can sit back, smoke their pipe and complacently "let 'er go." Why they should think that any mechanical device does not need maintenance is something I will never understand. Too many do nothing about repairs until something is obviously wrong. In the study Art Kuranz made of water uses in the average home, he found that 11.5 per cent of the total use was at rates of ¼ gpm or less. If a meter is not registering within the accepted standards at these rates, is it obvious? No, and the utility is losing revenue from the quantity of water and getting a distorted picture of leakage in the distribution system.

The frequency that a meter should be overhauled is so dependent upon water quality that it is not proper to say that a meter should be brought into the shop every X years. If the manager has no information on the frequency that may be required with the water quality he must contend with, to assure optimum registration, he should immediaely make such a determination by bringing meters in at certain intervals and continuing such research until he finds the number of years the meter will operate within satisfactory limits. It goes without saying that the meter must be properly sized. In other words proper sizing and proper maintenance are just as important as having a meter on every service.

More could be said on this subject, but I believe the above covers the basic points, and I feel better unburdening myself. Thank you for listening and your patience.

Sincerely,

Cliff

P.S. I failed to state that the manager of the water utility in that enterprising community won. The Commission dropped the matter of reverting to flat rate schedule.

CHLORINATION GUIDE

This first of a series of six articles on chlorination practices is devoted to . . .

Chlorination of Water

by EDMUND J. LAUBUSCH, Sanitary Engineer
The Chlorine Institute, Inc.*, New York, N. Y.

AUTHOR'S NOTE: The purpose of this series of six articles is to review briefly the fundamental principles of chlorination processes, especially as they relate to conventional water and waste treatment practices; to point out some of the principal hazards and flagrant abuses that are associated with chlorine use, and various means by which these can be minimized or corrected; and, to delineate, in a practical way, safe and effective handling techniques using equipment evolved from the cautious but rapid advancement of the science and art of chlorination.

Writings on this subject are voluminous, but no single treatise is or can be complete unto itself. This series of articles is not purported to contain all or even a majority of principles, facts or techniques relating to any facet discussed. The information is believed to be reliable and to reflect the experience of a number of producers, distributors and consumers of chlorine. With regard to safety suggestions, readers are cautioned that certain circumstances may warrant modified or additional procedure; moreover, they should not be confused with federal, state, municipal, insurance or other requirements that may be pertinent.

■ CONSIDERABLE PROGRESS has been made in the use and development of chlorination practices at sanitary installations during the past half century (see Fig. I-1). Out of these years of experiment, experience and intelligent operation have crystallized certain practices and policies well worth the consideration of persons in any way associated with the handling or use of chlorine.

Development

Fifty years have passed since chlorine was first introduced on a plant scale to the Boonton reservoir supply of the Jersey City, N. J. water works system. Clearly, the effectiveness of continuous chlorine disinfection in practically eliminating such waterborne diseases as typhoid and cholera is responsible for its wide spread adoption and continuous development in the United States (see Fig. I-2).

Not all of the public health protection afforded by modern water treatment technology can be attributed to chlorination practices. That the value of chlorine disinfection is recognized is evidenced by the fact that almost 50 per cent of all existing water treatment plants in this country in 1948 employed it as the only form of treatment. Moreover, in that same year (see Fig. I-3) a total of 6135 plants, serving more than 80 million people, employed chlorine disinfection alone or in conjunction with other water treatment processes. This represented some 87.8 per cent of the population served by *all* community water works systems, both with and without treatment.

In water chlorination, as in the somewhat allied field of sewage chlorination, there often is an unfortunate tendency to follow blindly in the wake of authority or novelty, forgetful that

*The Institute and its members make no guarantee of results and assume no liability, joint or severally, in connection with the information herein contained or the safety suggestions herein made.

no two problems are identical and that a treatment regimen, excellently suitable in one case, may be totally inapplicable in another. The following discussion relates patricularly to fundamental principles of water chlorination although much of it applies equally to the chlorination of sewage and other wastes.

Chlorination Theory—Chemical & Biological Effects

The reaction mechanisms involved in the addition of chlorine to water superficially appear to be very simple. In reality, however, this is not at all the case: First, waters to which chlorine is added are not simply H_2O but are, in fact, extremely complex solutions of many elements and their compounds, including varying amounts of numerous organic substances of animal, vegetable, and synthetic origin; and, secondly, the reaction does not yield a simple addition compound, xCl_2yH_2O. When chlorine is added to waste-bearing waters, the situation is even more complex.

When chlorine (a solution of chlorine gas or hypochlorite) is added to water—reducing the reaction to its most elementary form—a mixture of hypochlorous acid (HOCl) and hydrochloric acid (HCl) is formed:

$$Cl_2 + H_2O \rightleftarrows HOCl + HCl$$

The hypochlorous acid ionizes or dissociates into hydrogen and hypochlorite ions:

$$HOCl \rightarrow H^+ + OCl^-$$

Both reactions are dependent upon the pH value of the water. From its mass action equation it can be readily demonstrated that molecular chlorine can not exist in waters above pH 3.0. Between pH 6.0 and 8.5 there occurs a very sharp change from undissociated to completely dissociated hypochlorous acid. Chlorine exists predominately as HOCl at low pH levels; above pH 7.5 hypochlorite ions (OCl^-) predominate, while above pH 9.5 chlorine exists almost entirely as OCl^- (see Fig. I-4).

The utility of chlorine in water treatment is attributable to its toxicological characteristics and its high oxidative capacity (see Figs. 1-5, 6). Chlorine is employed either to destroy or control bacteria, (or both) or to modify the chemical characteristics of the water being treated. Among those variable components of natural water supplies that often affect water chlorination are:

- Alkalinity
- Oxidizable metals
- Other oxidizable inorganic substances
- Ammonia and amines
- Oxidizable organic substances
- Bacteria and other organisms

Alkalinity. Hardness-producing materials, principally the carbonates and bicarbonates of calcium and magnesium, tend to buffer water against significant changes in pH that otherwise would accompany the addition of small amounts of acids and alkalies. As noted later, if chlorination is to be efficacious, either as a chemical oxidant or for disinfection, an optimum pH range must be maintained.

From the equation of the hydrolysis of chlorine it is evident that the hypochlorous and hydrochloric acids produced will tend to lower the pH; each part of chlorine added reduces the alkalinity by about 1.22 parts (as $CaCO_3$).* When sufficient chlorine is applied to deplete the natural alkalinity to such an extent that the pH is substantially decreased, then pH correction may be indicated as an auxiliary treatment. (Solutions of hypochlorite always contain an excess of alkali which, if anything, will tend to raise the pH value, usually by insignificant amounts.)

Oxidizable Metals. In water treatment, the primary method of iron and manganese reduction is by oxidation of soluble ferrous and manganous forms to the insoluble hydroxides, followed by precipitation. Where chlorination is employed for disinfection, and in the presence of these metals, sufficient chlorine must be added to satisfy the bacteriological demand as well as that from these sources.

If chlorine is used as the oxidizing agent, iron or manganese will not be removed unless the pH is high enough

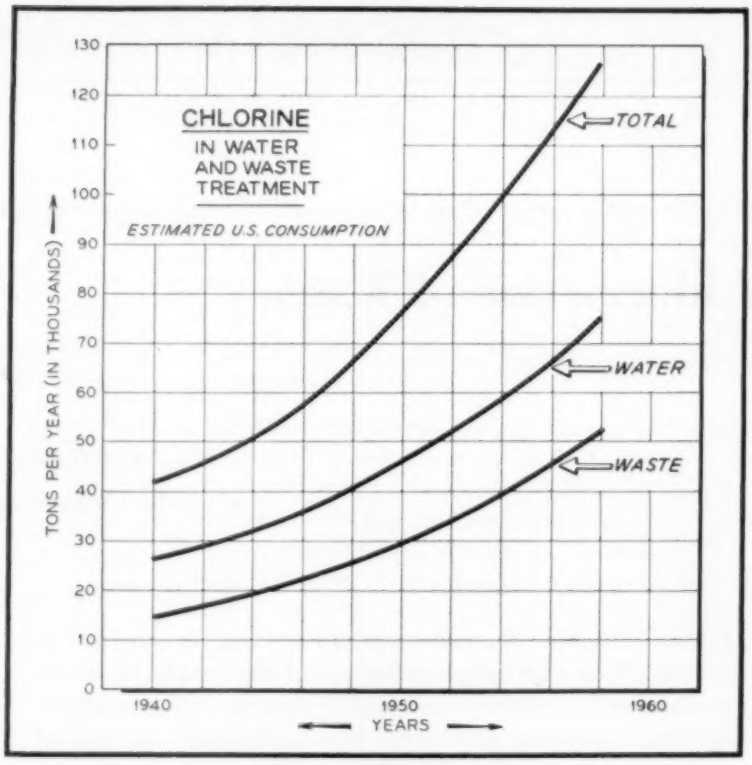


FIG. I-1. ESTIMATED use of chlorine for disinfection and other purposes at water and waste treatment facilities in the United States.

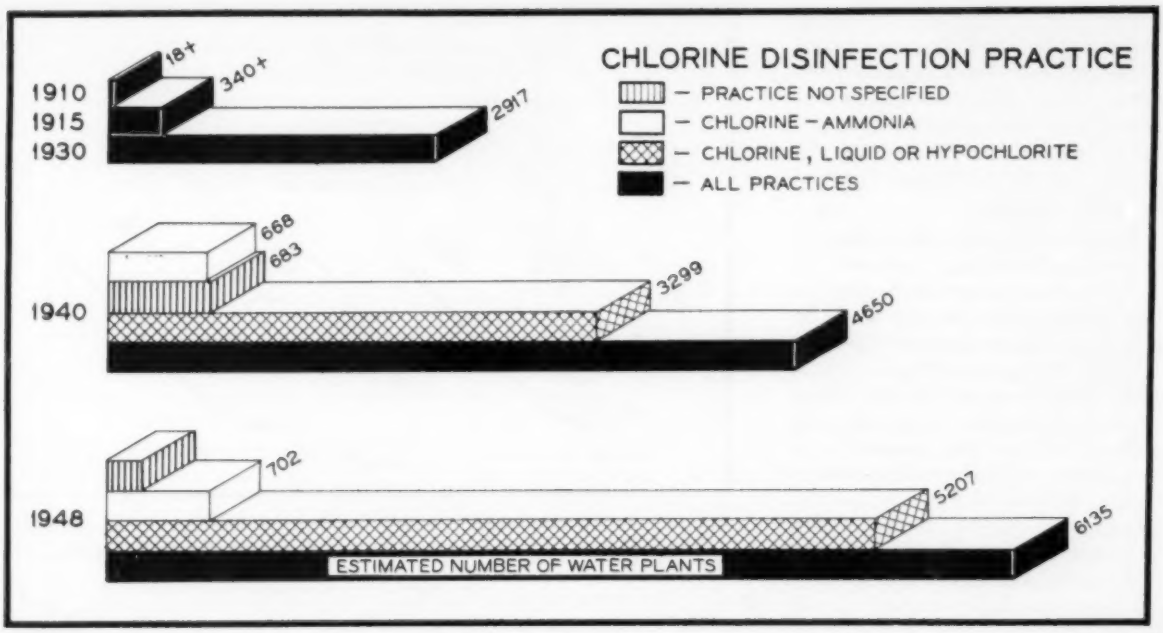


FIG. I-2. NUMBER of water plants and type of chlorine disinfection practice employed in the United States: 1910-1948 (From Statistical Summary of Water Supply Treatment in the U.S. by John R. Thoman. PHS Publ. 301, 1953)

for hydroxide formation. For iron removal the optimum pH is 7.0 or above, and for manganese removal the optimum pH is 10. About 0.6 and 1.3 parts* of chlorine are required, respectively, for each part of Fe and Mn removed, and about 0.9 and 3.4 parts of alkalinity (as $CaCO_3$) are consumed.

Chloramines do not enter vigorously in these oxidation reactions. For satisfactory manganese removal, free available chlorine (as distinct from combined available chlorine) should exist.

Other Common Oxidizable Materials. Hydrogen sulfide theoretically can be oxidized by chlorine to sulfite, or sulfate, the last-named representing usual practice when chlor-oxidation is employed. To remove one part H_2S requires about 8.5 parts* of chlorine; about 10 parts of alkalinity (as $CaCO_3$) are consumed by the reaction which occurs optimally at about pH 9.

Nitrites are occasionally found in some water supplies, particularly those contaminated by sewage and certain industrial wastes. Nitrites are readily oxidized by chlorine, especially free chlorine, to nitrates and HCl, each part of nitrate consuming about 1.5 parts of chlorine. These sources of chlorine demand also may be significant in adjusting the chlorine dosage to accomplish the desired objectives.

Ammonia and Amines. The reactions of chlorine with ammonia are of great signficance in chlorination of water, particularly in disinfection. When chlorine is added to water containing natural or added ammonia, a combined available chlorine residual (containing little or no free available chlorine) is obtained. The following equations suggest what might occur.

$$NH_3 + HOCl \rightarrow NH_2Cl + H_2O$$
(monochloramine)

$$NH_3 + 2\,HOCl \rightarrow NHCl_2 + 2\,H_2O$$
(dichloramine)

$$NH_3 + 3\,HOCl \rightarrow NCl_3 + 3\,H_2O$$
(trichloramine or nitrogen trichloride)

$$2\,NH_3 + 3\,HOCl \rightarrow N_2 + 3\,H_2O + 3\,HCl$$

The chloramines are profoundly different in their bactericidal properties from free chlorine forms.

If sufficient chlorine is added, a point is reached where all ammonia is oxidized, substantially to nitrogen, and the chlorine itself is reduced in the process. Further additions of chlorine will then provide a residual of *free available chlorine* as HOCl or OCl^-. Below this point, chlorine residuals exist as *combined available chlorine*, consisting essentially of mono- and dichloramines in various proportions depending largely on pH (see Figs. I-4, 7).

Reactions analogous to those between chlorine and ammonia also occur to varying degrees with organic amino groups. While certain organic chloramine residual complexes do possess some bactericidal properties, they do not nearly compare in rate of bactericidal action with that of organic chloramine and free chlorine residuals.

Oxidizable Organic Substances. There are a great number of organic substances in waters that react with chlorine (and chloramines) at various rates and under various conditions. These may exert a substantial influence on the chlorine demand of the water, depending on chlorine concentrations and reaction time. (For this reason both variables should be specified in any definition of chlorine demand). When such conditions exist, chloro-addition and chloro-substitution products might be formed (some of which may exhibit some bactericidal properties), or the organic matter may be completely oxidized. Such consid-

*A part can be a mg/L (ppm) or lb/mil gal or any other value as long as one unit of measurement is used throughout the relation or calculation.

erations are important in establishing a chlorination regimen.

Bacteria and Other Organisms. As already noted, although chlorine as a chemical oxidant has considerable utility in water treatment processes, its primary use for disinfection is by far the most important.

Several theories have been advanced to explain the mechanism of bacterial destruction or inactivation by chlorine. The current belief is that death results from the action of chlorine on essential bacterial enzymes, particularly triosephosphate dehydrogenase. According to theory, hypochlorous acid (HOCl) exhibits greater ability to penetrate the cell membrane and to oxidize the essential enzyme(s) than hypochlorite (OCl^-) and other chlorine forms. Similarly, investigators suggest that monochloramines are less effective than dichloramines.

Two practical considerations become immediately apparent: first, the bactericidal efficiency of free chlorine is greatest when existing as HOCl and the more highly substituted chlorine derivatives of ammonia; and, second, spores and cysts—because of their resistance to penetration—are less susceptible to chlorine than vegetative bacterial forms. The first consideration can be properly dealt with largely by pH adjustment, while the second involves limitations not always fully compensated by adjustment of chlorine dosage and contact periods.

Chlorine Disinfection

Chlorine treatment has never been authoritatively advocated as a substitute for filtration and certain other unit water treatment processes. However, neither can the occasional claim be supported that filtration and sedimentation provide effective protection against bacterial pollution.

Fundamentally, to ensure freedom from pathogenic bacteria it is only necessary to provide a certain residual (excess of chlorine) at the end of a given period of time after chlorination. The character and magnitude of the residual, and the period of time, are largely reciprocally interdependent and depend on such factors as pH, temperature, organic pollution, and the presence of ammonia and other amino compounds capable of forming chloramine complexes. In general, low pH accelerates, low temperature retards, and the presence of ammonia, amino and other organic materials diminishes the bactericidal potential of available chlorine in either free or combined form.

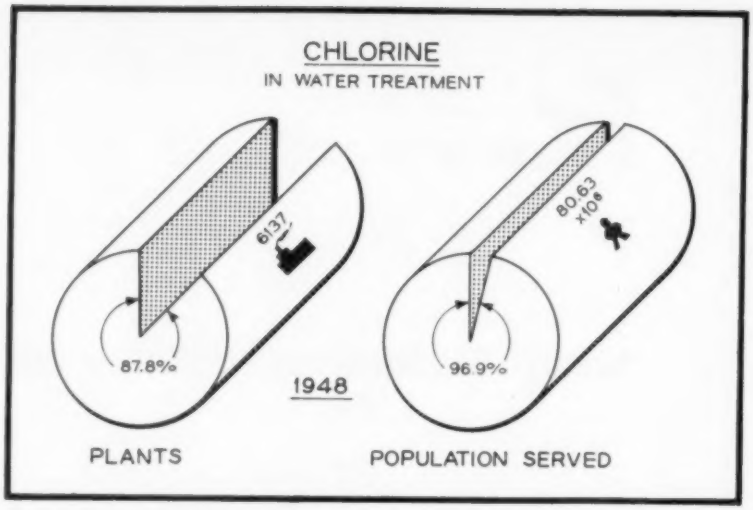


FIG. I-3. WATER TREATMENT plants in the U.S. employing chlorine disinfection in 1948 and estimated population served. (Source: Same as Fig. I-2.)

pH. As indicated previously, solutions of chlorine gas in water tend to lower the pH and consume alkalinity. This does not apply in the case of hypochlorites that are alkaline and, in fact, actually tend to raise the pH slightly. It has been demonstrated that the efficiency of chlorine as a bacteri-

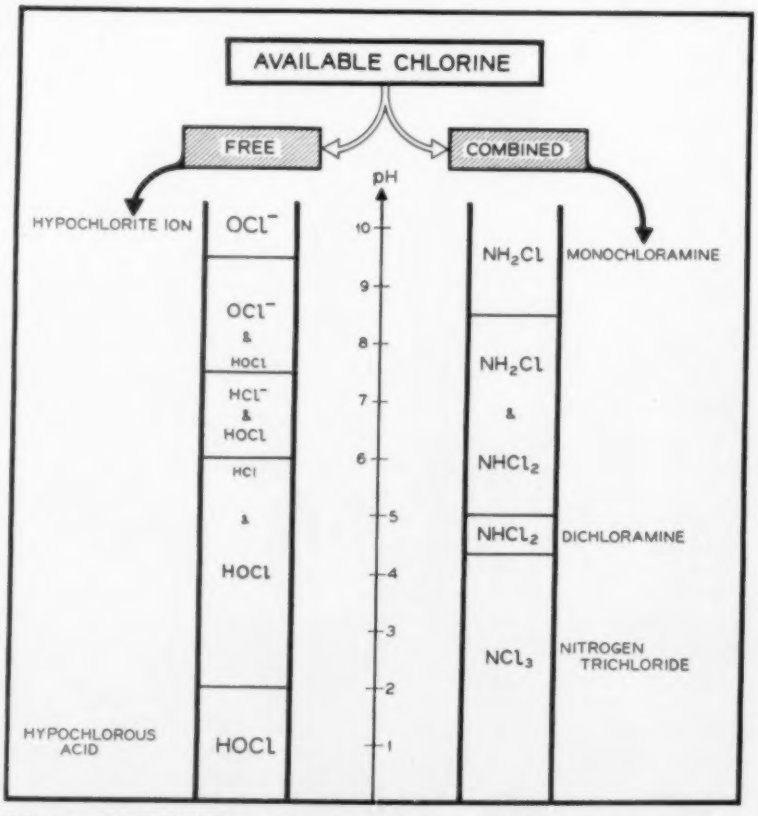


FIG. I-4. RELATIONSHIP of pH to free and combined forms of available chlorine.

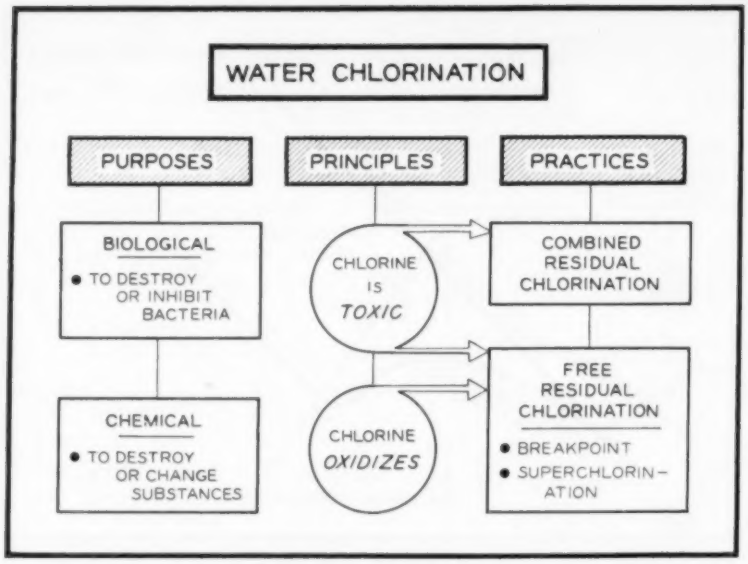


FIG. I-5. APPLICATION of chlorine in water treatment.

cide depends on how it exists, both in the free and combined forms: in the former, hypochlorous acid (existing predominately at pH 6 to 7.5), and in the latter, dichloramine (existing predominately at pH 4.4 to 6.5) are the most potent (see Fig. I-4).

It is apparent, then, in the pH range normal to most domestic water supply sources, that a reduction in the bactericidal potential of free chlorine and chloramines (especially) occurs at higher pH. While for some purposes it may be desirable to adjust the pH to an optimum level for disinfection, it might also be desirable to operate at a slightly higher pH as an adjunct to coagulation, for sulfide oxidation, corrosion control or other purposes.

Temperature. The bactericidal capacity of free chlorine and chloramines increases with rising temperature. Diminished rates of bacterial reductions are especially apparent when a combination of lowered temperature and high pH occurs.

Time. The resistivity to chlorine exhibited by bacteria and other organisms varies greatly. In addition to the above factors, whether chlorine exists as free chlorine or as chloramines, sufficient contact must be provided to effect complete destruction of all pathogens and other organisms of sanitary significance. Other conditions being the same, the time required for free chlorine forms is considerably less than that required for chloramines although the latter persist for much longer periods. It generally is considered that with the same amount of residual a contact time about 100 times as great is required for chloramines to accomplish equivalent bacterial kills.

Form of Available Chlorine. It is well established that combined available chlorine forms—principally the chloramines—are far less active than free available chlorine forms existing especially as hypochlorous acid. It has been suggested that the relatively low oxidation potential of chloramines accounts for this phenomenon. About 25 times as much chloramine as free chlorine is necessary to effect equivalent bacterial kills during the same contact period.

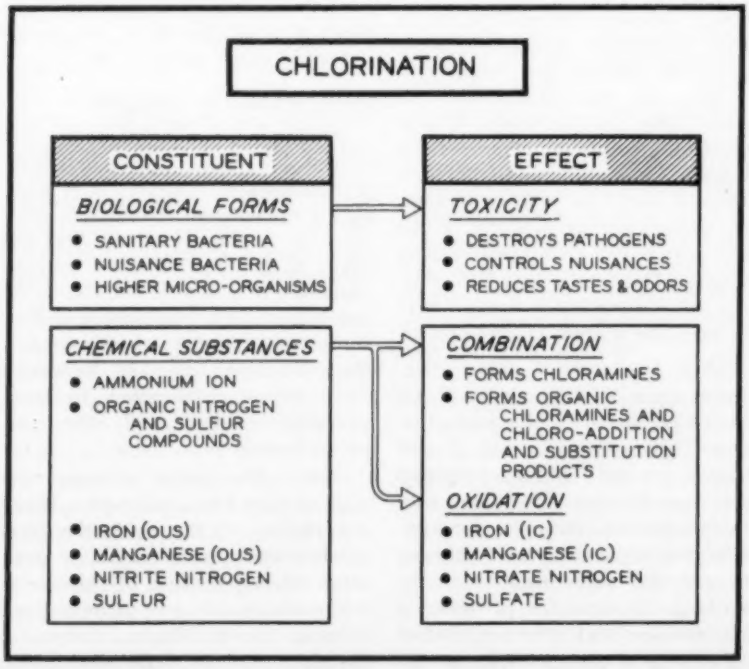


FIG I-6. BIOLOGICAL and chemical effects of chlorine in water and waste treatment.

Free and Combined Chlorine

The type of available chlorine residual required and the characteristics of the water being treated determine the process of disinfection to be employed or maintained. All chlorination practice, irrespective of the point of application, may be classified as free available residual chlorination (i.e., breakpoint or super-chlorination) or combined residual chlorination, depending upon the nature of the chlorine residual formed. Both types, satisfactorily employed, will yield a safe water: from a practical viewpoint, however, both are not equally applicable to all water sources for disinfection or to enhance auxiliary objectives (see Fig. I-8).

Free Available Residual Chlorination. As previously noted chlorine reacts with ammonia and other impurities in water to form combined

available chlorine forms.* If sufficient chlorine is added, the residual will exist almost exclusively as free available chlorine when ammonia is destroyed. The "point" of maximum chlorine demand, beyond which the residual rises in proportion to the dose, is called the *breakpoint*. It is not absolutely essential that the breakpoint be reached to accomplish disinfection providing sufficient time is allowed for chloramines and other chlorine complexes to exert their effect.

Beyond the breakpoint, the chlorine dose (and form) usually is sufficient to satisfy the chlorine demand due to less-resistant bacterial forms and some easily oxidizable inorganic and organic constituents of the water, as well as to provide a slight residual of free chlorine to attack more resistant bacteria and other more complex chemical impurities. Moreover, the addition of substantial excess chlorine—the process of superchlorination—will result in further satisfaction of the chlorine demand and oxidation of organic complexes such as those that give rise to tastes, odors and colors. (Destruction of bacteria is, of course, rapid and complete when superchlorination dosages are employed.) Subsequent dechlorination usually is necessary to render the water palatable when superchlorination is practiced.

High free residual chlorination is especially indicated where the raw water quality is poor, for manganese (and sometimes iron) reduction, or when the contact time with marginal chlorine dosages is insufficient to effect disinfection. Moreover, it is useful where tastes exist before treatment and to destroy objectionable tastes due to substances that react with small quantities of chlorine (in contrast to strictly chlorinous tastes that can readily be removed by natural or artificial dechlorination).

Large doses of chlorine oxidize and destroy taste-producing substances, and breakpoint or superchlorination may be successful in taste control if water contains phenolic compounds, certain algae growths, etc. where other treatment is ineffective. The amount of chlorine required and, thus, the treatment process to be employed to break down odor producing bodies, depends on the type of intensity of pollution; 1 mg/L may be sufficient to reach the breakpoint in some waters, while others might require 10 mg/L of chlorine or more.

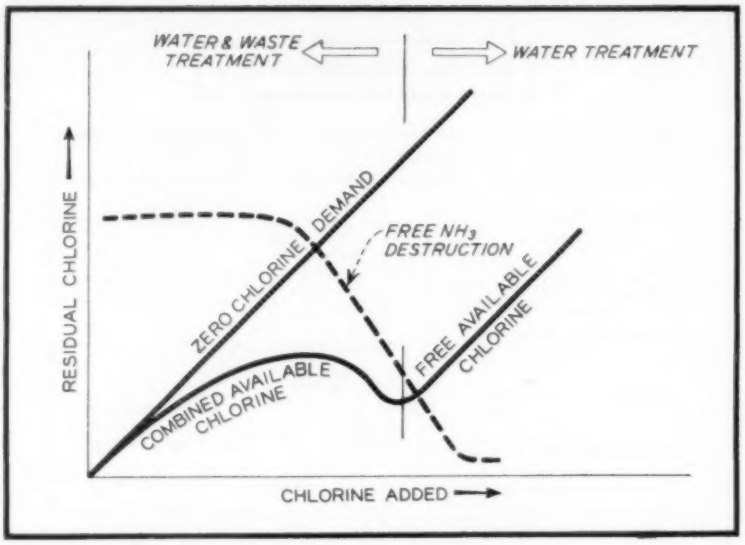


FIG. I-7. FREE and combined residual chlorination.

Combined Available Residual Chlorination. Combined available chlorine forms, principally inorganic chloramines, are effective for disinfection providing the concentration and exposure time are adequate. Unless bacteriological tests demonstrate otherwise, generally it is advisable to provide a minimum of 30 to 60 minutes contact before delivery to the consumer. Rapid disinfection cannot be expected but once effected, the residual will persist much longer than free available residual chlorine forms.

Unlike free residual chlorination, chlorine-ammonia treatment will not greatly alter tastes existing in the raw water (by oxidation), but it will offtimes prevent chloro-substitution tastes from forming. The process usually is effective, however, for controlling aftergrowths and reducing dead-end red water troubles in the distribution system, for providing a high, tasteless and effective residual at the point of consumption, and for control of certain algae forms. Where iron or manganese removal, color reduction, control or difficult taste and odor problems are specified, free residual chlorine treatment usually is more effective and economical.

Where chlorine-ammonia treatment is indicated, ammonia (generally as a gas, but also in aqueous form, or as a compound such as ammonium sulfate) may have to be added to some waters to obtain the desired effects. Since it is a critical constituent of the reaction, the concentration must be carefully controlled. In practice, about three parts of chlorine to one part of ammonia yields good results.

Points of Chlorine Application

Although chlorination policy has been molded by experience into fairly well established channels, it is abundantly evident that chlorination practices are varied. Not only does this apply to combined and free residual chlorination practices, but also to the points at which chlorine is utilized in water and waste treatment systems. Basically, these depend on the specific objectives of chlorination, technical, practical, economic and other considerations.

When chlorination of water was first employed for disinfection, terminal treatment of the purification plant effluent was almost invariably practiced. Today, the use of chlorine in various stages of water treatment, and even in the distribution system, is common practice. Split chlorination schemes are increasingly employed for disinfection and other purposes, and

*The reaction of hypochlorous acid with ammonia is not instantaneous, the speed depending largely on the pH and temperature. Thus, for a short period after the addition of chlorine to a water containing ammonia, some free chlorine will exist and, until this has reacted to form chloramines, it will react with the vigor associated with free available chlorine forms. Thus, under these conditions the bacterial kill will be greater than that due to combined available chlorine to the extent that it is less affected by temperature, pH and relative ammonia-chlorine concentrations.

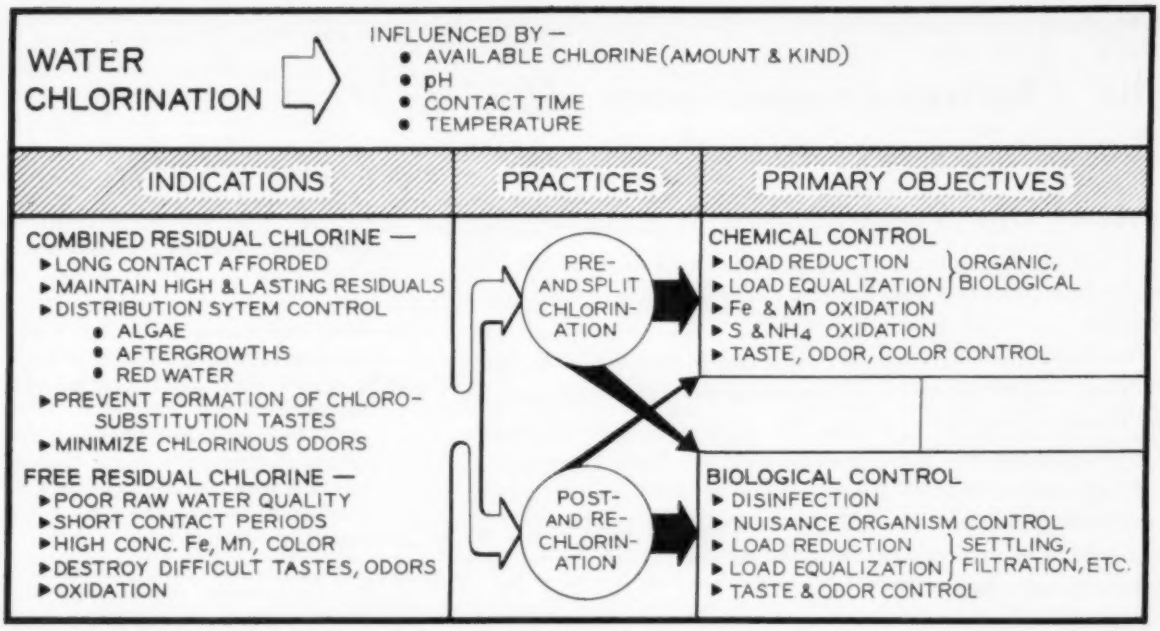


FIG. I-8. SUMMARY of principles of conventional water chlorination.

frequently enhance the efficiency of many unit water treatment processes.

Pre-chlorination. Pre-chlorination is the application of chlorine to water prior to any other unit treatment process. Among the benefits claimed for the practice are: Improved filter operation by reduction and equalization of the bacterial and algae load, control of slime and mudball formation; improved coagulation; reduction of taste- odor- and color-producing materials by oxidation and retardation of decomposition (in settling units); and, importantly, the provision of a safety factor in disinfecting heavily contaminated waters while keeping the chlorine residual in the distribution system at a minimum. Chlorine treatment is not, however, the unfailing panacea for all these ills.

When pre-chlorination is indicated it is usually desirable to obtain a contact period as long as possible, preferably by adding the chlorine to the raw water suction intake and insuring its contact with water during the entire treatment process. The dosage, of course, depends on the objective. For example, if manganese oxidation is desired, free residual chlorine dosage is indicated; if decomposition retardation, removal of small amounts of color and iron, or use as a coagulant aid (e.g. activated silica) is the objective, combined chlorine forms may suffice.

Post-chlorination. Post-chlorination is the application of chlorine to water subsequent to any other unit treatment process. The most important form of post-chlorination is that following filtration for disinfection and to provide an active chlorine residual in a part or the entire potable water distribution system. The contact period provided to effect disinfection, as discussed elsewhere, is an important consideration; chlorine usually is added to the filter effluent or at the filter clear well.

Rechlorination. Rechlorination is the application of chlorine to water, following previous chlorination treatment, at one or more points in the distribution system. The practice is especially common where the distribution system is long and complex and where the effluent residual is insufficient to control biological growths, red-water troubles, etc.

Dechlorination. Superchlorinated water (as discussed) usually contains an esthetically objectionable excess of free available chlorine which must be removed before it is acceptable to consumers. Prolonged storage (especially in sunlight) and absorption on activated carbon are effective for this purpose. Also, such reducing compounds as sulfur dioxide, sodium thiosulfate and sodium bisulfite are frequently employed as dechlors. When sulfur dioxide is employed for this purpose (yielding HCl and H_2SO_4), about one part (by weight) is required for each part of chlorine to be removed.

Chlorine-Ammonia Treatment. Except where chlorine-ammonia treatment is employed to prevent tastes and odors being formed or increased in intensity during the various treatment processes, the general trend is to employ a split chlorination schedule, pre-chlorinating with chlorine alone, followed by chlorine-ammonia treatment after filtration.

The points of application of ammonia and chlorine should be sufficiently far apart to permit thorough mixing of the ammonia with the water before chlorine is applied, but not so great as to permit dissipation of ammonia by organic matter before chlorine is added. The prior addition of chlorine may result in the formation of chloro-substitution products unaffected by chlorine-ammonia treatment.

Acknowledgment

Figures illustrating typical biological and chemical effects of chlorine in the treatment of water and wastes were developed from a concept suggested by Harry A. Faber, formerly research chemist of The Chlorine Institute, and presently Research Coordinator, Engineering Resources Program, Div. of San. Eng. Services, U. S. Pub. Health Service, Washington, D. C.

In the course of the past hundred years, a great deal has been accomplished by . . .

The Thames Conservancy *1857-1957*

by JOHN FINCH, Manager
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Slough, England

AUTHOR'S NOTE: A recent paper by W. G. Barclay, Chief Inspector of the Thames Conservancy, on the work of that body during the last 100 years, spotlights a river; an organisation, and a Report.

The River is the Thames; the organisation is the Thames Conservancy, and the Report is a fascinating document published by the Thames Conservancy to mark the centenary of the formation of a body known as "The Conservators of the River Thames."

A foreword written by the Chairman of the Conservators, Sir Jocelyn Bray, records some of the most interesting historical details ever to be associated with pollution prevention, dating back to the eleventh century.

■ FROM THE FOREWORD of the Report on the Thames Conservancy comes this quotation:

"In 1065 and 1066 Edward the Confessor made a decree concerning the four Royal Rivers, the Thames, the Severn, the Trent and the Yorkshire Ouse.

"He ordained that mills and fisheries be destroyed, the waters repaired and the tribute to the King be not forgotten.

"What happened to the mills we do not know, but many have sprung up since and even today the interests of navigation, the mills and the head water they want, the drainage of the land and the anglers on the river do not always harmonize.

"After nearly 900 years the chief instructions to all our Staff are exactly the same. We do repair the waters and maintain the weirs and locks and do our utmost to prevent all pollution.

"Perhaps those who pay registration fees and lock tolls may almost feel proud when they realize that they, too, are still paying 'tribute,' if not to the King, but to us, his successors in title.

"Until 1350 it was the Royal Prerogative to manage these Royal Rivers, but in 1197 King Richard the First sold his rights in the Thames to the Corporation of London in order to get funds for carrying on his Crusader campaigns in Palestine.

"The Corporation struggled to retain these rights but they gradually diminished and all that remains now is their right to appoint one Conservator, which, I am glad to say, they still do.

"On the left bank of the Thames just above Staines still stands 'The London Stone' erected circa 1285 by the Corporation of the City of London to show their rights.

"This stone was visited by Sir Rupert de la Bere, Lord Mayor of London in the Coronation year and in this Centenary year by the present Lord Mayor of London, Sir Cullum Welch.

"Magna Carta alluded to the Thames and said 'Let all kiddles be abolished.' The kiddles were primitive weirs of stakes and brushwood put up to keep a head of water for the millers, and large quantities of small fish were caught in them.

"The peasants who looked to fish for some of their food were upset and in one petition it was complained that mill owners caught the fish and fed them to swine, which was 'against the Will of God.'

"By the early seventeenth century the navigation had got into a bad state. There were no railways and roads were bad and the Thames was an important means of communication.

"There were no pound locks as we know them but only the flash looks which were weirs and gates at the end of long reaches and a whole reach had to be nearly emptied to let traffic up and down, and progress was very slow.

"In 1605 and 1624 James I appointed Commissions above Staines and they built the first pound lock at Iffley, but otherwise did not do much.

"In 1751, after a bitter fight with the Corporation of London, the Thames Commissioners, 600 in number, were appointed to manage the river above Staines and they gradually built the pound locks above Staines, whilst the Corporation built those below."

The history of the Thames Conservancy compiled by the Secretary, opens with an account of the events which led up to the passing of the 1857 Act. The rights in the bed and soil of the tidal portion were held by the City of London until these were challenged by the Crown by suit in Chancery brought in 1844. The suit was never tried, but settled by agreement in 1856, by which the corporation acknowledged the title of the Crown and paid £5,000 to the Commissioners of Woods, Forests and Land Revenues in satisfaction of outstanding claims. The Commissioners then conveyed to the corporation as conservators all the rights of title of the Crown in the bed, soil and shores of the Thames from Staines to Yantlet Creek in the county of Kent. The City then brought a Bill before Parliament vesting these rights "within the flux and reflux of the tides" in a permanent body of conservators. The newly-constituted board held its first meeting in the Mansion House on 7th October, 1857.

Later, in 1866, the Conservators took powers over the upper reaches of the river, between Staines and Cricklade, and the old Upper Navigation Commissioners were disbanded. The next major change was in 1909, when the conservators lost the tidal

portion below Teddington Weir to the Port of London Authority. The conservancy's catchment area now extends over 3,843 square miles, including 594 miles of main river, of which 137 miles is the Thames itself.

Writing of the early days of river management, Sir Jocelyn Bray says that the eighteenth century Thames Commissioners who built the pound locks and weirs for navigation little knew that without them, the Thames could never have supplied London with the amount of water it wants now.

Every lock and weir from Lechlade downwards is of importance. They hold up the water in every reach to a certain height and this in turn holds up the water in thousands of acres of land adjoining the river.

The actual water contained in the Thames itself is small. The whole river from Lechlade to Teddington only holds 4,500 million gallons at head level.

It is the vast amount of water held up in the land by the weirs that is important. This gradually seeps out in the summer and helps to keep up a reasonable flow.

If it were not for the weirs the Thames would be a raging torrent after a rain and a mere trickle in dry weather, and London's water supply could never have been kept up.

Concluding his foreword, Sir Jocelyn Bray says: "So much of the past, but what of the future? Can we doubt that the Conservators who succeed us will go on during the next 100 years maintaining and improving the service we have given to the public and will see that the beautiful unspoilt reaches of the Thames are not marred by ugly development.

"High above the banks of the Thames stands Windsor Castle, and may the future Kings and Queens of England be able to look down from the home to their Royal River and be able to see that the decree of Edward the Confessor nearly 1,000 years ago is still being carried out and 'the waters repaired.' "

Mr. Barclay's paper is a condensed version of the Report suitable for presentation to a technical body, but the Report or book produced by the secretary to the Thames Conservancy, Mr. G. E. Walker, is a much more lengthy publication.

The Spiral Pump

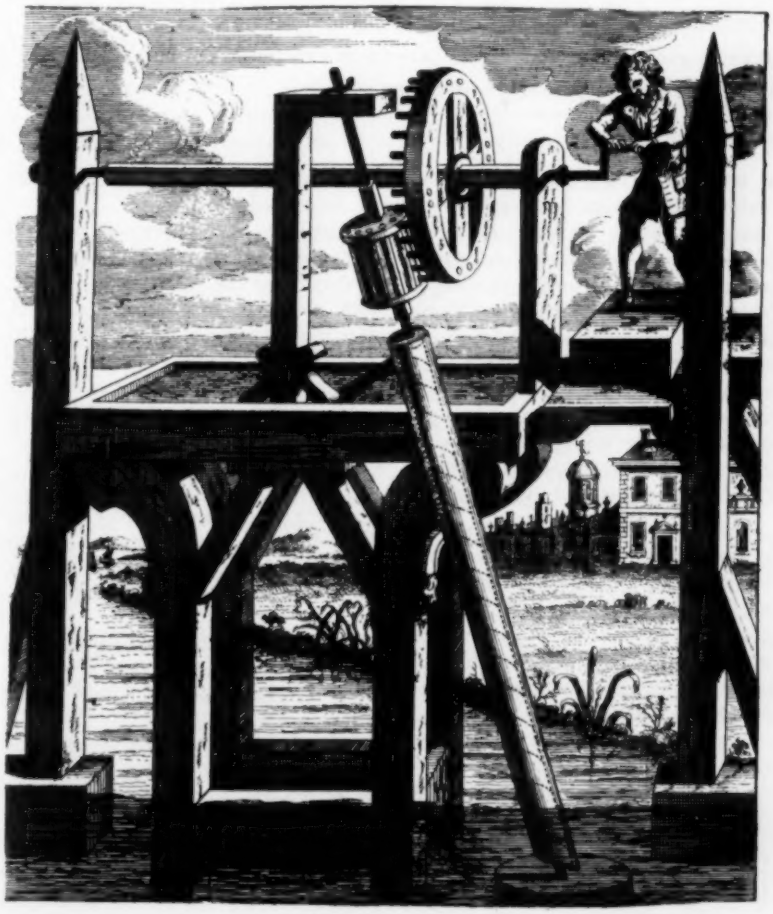
The story of the spiral pump commences with the Archimedes' screw. It is said that that classical scientist invented same for irrigation and drainage of land during his sojourn in Egypt.

It is a simple principle of a tube coiled corkscrew, like around a revolving inclined axis, which raises water by stepping the force of gravity with a free water discharge at the upper end of the screw. In later days it became known as the "Dutchscrew" because it was used in that low country during the middle ages for drainage.

In 1708, Lord Drogheda employed a Dutch engineer to erect a screw pump on his estate. The pump was located on the banks of the river Boyne in Ireland and served to supply water to his mansion. This modern pumping machine had a spiral tube which was rotated by a high geared turning handle and delivered water into a pan from whence it was piped to the courtyard and stableyard of the mansion. This type of pump became known in Ireland as "Lord Drogheda's Pump." It was erected at many other houses over the land. By the middle of the 18th century, Lord Dungannon had modified one of these pumps to turn by a light and high undershot water wheel located on the river Lagan at Bevoir Park, Belfast.

What seems so surprising, though water supply pump machines were first used in Ireland, to elevate water to the first floor of mansion houses was rare—bath houses being provided outside. Even to this day in this country which understood mechanical hydraulics so well so long ago, some great houses have no bathrooms or indoors lavatories.

—C. J. Robb, Timpany, Ballynahinch —Co. Down, Ireland



Although a proprietary rather than governmental function, sewer maintenance is an important public relations tool involving . . .

Sewer Cleaning and Safety Measures

by NORMAN W. NESTER, Civil Engineer
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EDITOR'S NOTE: As the result of continual observation and study of records of sewer cleaning and maintenance, the Physical Plant Department of the University of Illinois has developed realistic cleaning schedules and methods and has provided the tools to keep the entire sewer system in good operating condition and free from stoppage, flooding complaints and odors.

This article, read at the Sewage Works Operators Short Course held at the University under the joint sponsorship of the Illinois State Department of Health and the University, presents a review of the causes of sewer stoppages, methods of cleaning sewers, tools available, and the importance of safety measures in all sewer maintenance operations. Also presented are typical schedules of sewer maintenance at the University.

■ MUNICIPAL RESPONSIBILITY for maintaining sewers has long been a question in the courts. However, keeping sewers clean is not a governmental function, according to a recent legal decision in Oklahoma. Nevertheless, a few localities have laws making sewer cleaning mandatory and exempting them from damage liability, although most municipalities do maintain their sewers in good repair, because this is regarded as a proprietary, rather than a governmental function.[1]

Adequate maintenance of sewers, although not a government function, becomes a very important tool in a good public relations program. Good public relations are a necessary function of any governmental agency, and good performance is essential to public relations.[2]

What Causes Stoppages

Operational failures or stoppages in modern sewers usually arise as a result of poor installation, root growth, grease, or introduction of uncommon materials and debris of such size as to cause clogging.

Employment of a qualified engineer in the planning, developing, designing, and construction of a sewer system will eliminate many failures which can normally be attributed to faulty installations.[3] Rigid inspection during construction will eliminate subsequent joint failures, with resultant savings in maintenance requirements.

In most cases, sewer clogging is a gradual occurrence, and a planned cleaning program will reduce the number of complete stoppages. Obstructions found in sewers may be classified in four general categories, as follows:

1. Materials that can be flushed out of the sewer, such as sand or grit.
2. Greases and slimes that adhere to the sewer walls.
3. Bricks, metals, and other materials not normally found in a sewer.
4. Tree roots.

Flushing Procedures

Flushing is accomplished by producing in the sewer a stream of water with sufficiently velocity to produce turbulence. Fushing loosens the sediment, places it in temporary suspension, and then moves it out of the sewer. Thus, sufficient flow must be produced to move the material to a section of sewer that has sufficient velocity to scour and keep itself clean. Where grades are flat or sewers lack the necessary velocity, the flushing process must be repeated in successive sections downstream from the troublesome section as far as required to remove the material.

The simplest method of flushing is through use of hose and water from a fire hydrant, and the hose may even be condemned hose from the fire department. To prevent pollution of the water system, which might occur as a result of negative water main pressures, there should be a vacuum breaker on the fire hydrant used in flushing. To prevent the water from flowing upstream in the sewer during the flushing operation, there are available bags which can be attached to the front of the hose with a nozzle on the outlet. The bag expands as water is introduced and prevents the water from backing up.

Other devices for flushing with hose are: (a) a nozzle with small jets directed upstream with sufficient force to propel the flushing nozzle downstream, and (b) a nozzle which rotates blades in front of it as it is moved down the sewer.

Flushing with sewage is also a common practice. This can be accomplished by plugging the sewer at a manhole and permitting the sewage to surcharge before removing the plug. The same effect can be created by introducing into the sewer above the stoppage a beach ball or elongated bal-

Schedule of Maintenance Work Sanitary Sewer Locations

	Location	From	To	Size	Items to be done
		Mathews Ave. Lateral			
1	Mathews	Green	Illinois	8"	3, 4, 5
2	University Men's Club Lateral			6"	4
3	Mathews & Illinois Depressed Section			2-8"	2, 3
4	Mathews	Illinois	Nevada	8"	3, 4, 9
5	Noyes Lab. Depressed Section			2-6"	2, 3
6	Chemistry Annex Depressed Section			2-6"	2, 3
7	Agronomy Greenhouse Depressed Section			2-6"	2, 3
8	Observatory Lateral			8"	4
		Green St. Lateral			
1	Green	Goodwin	Mathews	2-10"	9
2	Mechanical Engineering Laterals			6"	4
3	Green	Goodwin	Kings Hwy.	10"	3, 4, 6
4	Physics Laterals			6"	4
5	Natural History Lateral			10"	4
6	Civil Engineering Lateral			6"	4
7	Green	Mathews	C. E. Hall	10"	3, 4, 5
8	Illini Union Lateral			8"	7
9	Green	MH Eng. Hall	Burrill	10"	3, 4, 5
10	Altgeld Hall Lateral			8"	4
11	Green	Burrill	Wright	10"	3, 4, 5
		Wright St. Laterals			
1	Wright	Boneyard	Green	10", 12"	3, 5
2	Siphon on Wright at Boneyard			2-8"	2
3	Electrical Engineering Lateral			2-6"	4
4	Arcade Buliding Lateral			6"	4
5	Illini Hall Lateral			6"	4
6	Y. W. C. A. Lateral			6"	4
7	Davenport House Lateral			6"	4
8	1007 Wright Lateral			6"	4

FIG. 1—SAMPLE entries from a schedule of maintenance of sewers at the Univ. of Illinois: Numbers in right hand column indicate work to be done (see Fig. 2).

loon, which is floated down to the point of stoppage. There it elongates, permitting the sewage at increased head to by-pass it and thus loosen the obstruction through "jet" action. There are a number of devices of this type on the market.[4]

Rodding Cable Procedures

Grease stoppages are removed by either rigid or flexible rods. There are a number of tools and appliances which can be attached to the rods for cleaning purposes. These include wire brushes (porcupines), corkscrews, cutters, scoops, hoes, augers, serrated blades, and coils. House service sewers are cleaned by introducing a rotating rod, cable, or coil, with the previously mentioned devices on the front end of the tool. Where grease stoppages are a continuing problem, a program of periodic maintenance should be followed.

Winches or windlasses capable of pulling cleaning devices through the sewer may be used to remove heavy and bulky materials. A number of manufacturers produce this type of equipment.[4] The devices pull through the sewer cables with attached buckets of slightly smaller diameter than the sewer. The windlasses are either hand-operated or power-operated and will function with buckets of various sizes. Because of high cost, this type of equipment is usually found only in the larger cities. The winch-type cleaning device also may be used to remove sand and other settleable solids.

Root Removal

Of all the problems facing a sewer cleaning program, clogging by root growth is perhaps the most serious and most common. Although most stoppages are usually removable by flushing, root removal can only be accomplished with cutters or chemicals. Cutters and augers generally are power-operated.

Some municipalities have reported success in root removal by adding copper sulfate to the sewage.[5] Other chemical compounds that claim the control of root growth also are available.[4] Where tree or shrub roots are clogging a sewer, and produce continuing stoppages, it may be necessary to remove the tree. Care should be taken in making decisions for removal, because litigation may result.[6]

Both Curative and Preventive

Sewer cleaning and maintenance is, or should be, an important function in the work program of a municipality. Maintenance can be either curative or preventive. When maintenance is deferred until a breakdown or stoppage occurs, it becomes curative. When a department anticipates stoppages and cleans prior to the stoppage or breakdown, the service is termed preventive.

A preventive program of cleaning and maintenance will reduce stoppages

Sanitary Sewer Maintenance Schedule, University of Illinois

	Item Description	Item Number (by Frequency)* M	Q	S	A
I.	Make general inspection of entire system and prepare notes on manhole examinations, as follows:	—	—	—	3
	A. Odor of gasoline or presence of oil slick on surface of sewage.				
	B. Obnoxious or explosive gases.				
	C. Evidences of sand, grit, mud, or other debris.				
	D. Sluggish flow, septic sewage, or accumulation of sewage solids.				
	E. Excessively diluted flow.				
	F. Structural failures, including cracked or faulty masonry, incorrect grade of manhole cover, unsound manhole steps, and damaged, cracked or improperly seating covers.				
II.	Inspect manholes during heavy storms for excessive infiltration.	V	V	V	V
III.	Rod, cut, brush and/or flush entire sewer system.	—	6	9	5
IV.	Clean upper ends and flat grades.	—	1	—	—
V.	Clean inverted siphons and depressed sections.	—	2	—	—
VI.	Clean sluggish building lateral sewers.	8	7	—	4

*M=monthly; Q=quarterly; S=semi-annually; A=annually; V=varying, dependent on weather.

FIG. 2—ITEMS of work included on a maintenance schedule.

that may provide health hazards, property damage, and expensive major repairs. During World War II, the U. S. Army placed great emphasis on preventive maintenance and produced manuals for many types of operations, including sewers and sewage treatment.[7] An instruction text from the Illinois State Department of Health follows the general pattern of the Army program. A preventive maintenance program in sewer operation has been proven to be economical while providing an efficient service to users.

The Physical Plant Depatment of the University of Illinois has had a preventive maintenance program in both building maintenance and sewer maintenance for a number of years. Figure 1 shows some sample entries from a series of sheets of a schedule of maintenance performed on the sanitary sewer system at the University of Illinois. It will be noted that the sewer location, size, and limits are identified for each street. Also indicated in the right-hand column are the reference numbers for maintenance features to be accomplished. These numbers refer to items on a maintenance schedule (Fig. 2), which provides for inspection service as well as cleaning and maintenance of each sewer in the University sewer system.

Frequency of maintenance has been divided into four periods, as indicated in Figure 2. In addition to the schedules, the sewer crew is provided with 8½- by 11-in. sectional maps (scale 1 in. = 50 ft) bound in a looseleaf folder. The maps show the locations of sewers and other buried utilities. They aid the crew in coverage of the maintenance route and also locate utilities where excavation of a sewer is necessary.

Good Records A Must

A preventive program is of no value unless permanent and accurate records of the entire function are maintained. Figure 3 shows parts of the inspection and service card used by the University Physical Plant sewer crew. All data pertaining to maintenance of a sewer are kept on the cards, with a card provided for each branch sewer indicated in Table 1.

Much of the data on the face of the card can be copied from the information contained in Fig. 1. On the reverse side is recorded all maintenance completed, together with the date of completion and the initials of the crew chief. On the face of the card and at the top, the calendar months are listed. File signals are clipped to the card at the month or months during which the inspection and maintenance is to be carried out.

When the program was initiated at the University, frequencies and dates were selected by guess. As the program progressed, dates were altered and frequencies reduced or extended as needed. At present the schedule is spread throughout the year as much as possible and items are particularly designated during periods which will least interfere with other seasonal operations.

Maintenance of sewers at the University is completed by a crew of 3 to 4 men, depending on the operation. This crew is supplied with a four-wheel trailer equipped with all of the equipment and tools necessary to clean and maintain sewers.

The program as presented here, may, at first glance, seem to be quite extensive and detailed. However, it was adopted over a long period from the records accumulated as the normal function of cleaning progressed. The program covers all possible contingencies; when followed completely it provides for adequate maintenance and efficient service. Since the adoption of the maintenance plan, emergency calls have been reduced to an absolute minimum, with resultant increase in service efficiency. Furthermore, there have been no damage losses resulting from flooding since installation of the program.

The program is flexible enough to be adapted by any community and a plan similar to that utilized by the University will insure an efficient, economical operation of one of the most important services rendered by a municipal government.

Frequently, the function of sewer cleaning is provided by personnel drawn from other operations. As a result, the maintenance is haphazard and expensive installations suffer deterioration and must be replaced.

From the standpoint of safety and efficient maintenance practices, it is inadvisable to expect untrained personnel, without knowledge of the dangers involved or of the laws which regulate safety procedures, to clean

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	

UTILITIES INSPECTION & SERVICE RECORD

DESCRIPTION

LOCATION

MAINT. TO BE DONE BY:

ITEM NO.	WORK TO BE DONE BY	FREQUENCY	TIME

SERVICE RECORD

DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED

FIG. 3—HEADINGS on maintenance, front of card above, back of card below.

sewers and make underground repairs. In this connection, the matter of safety in sewer maintenance and sewage treatment, too often neglected, is of prime importance to those participating in this type of operation.

Safety Measures

Extreme precautions should be taken during all sewer cleaning and maintenance operations to prevent possible accidents. The accident rate in the field of sewer maintenance and sewage treatment operation can probably be traced in a large percentage to human error, lack of training, and negligence. Hazards to which sewer maintenance personnel are exposed can be separated into five groups,[8] as follows:

1. Physical injuries from mechanical failures.
2. Disease or complications caused by infection fom contaminated materials.
3. Disabilities caused by gas inhalation.
4. Collapse due to oxygen deficiency.
5. Effects caused by radiation.

Almost all injuries resulting from mechanical failures may be traced to lack of precautionary safety measures. Dropped manhole and inlet castings, faulty manhole steps, wearing of improper footwear, inadequate barricades and hazard signals, as well as general carelessness, provide the usual causes of such accidents. Continued training in safety education and the practice of normal safety measures will reduce the frequency of this type of accident.

Infection can be reduced through the use of protective clothing and by practicing normal safety measures. Cognizance of the possible infection hazards which exist will aid in elimination of this type of accident. Some municipalties provide treated coveralls, safety hats, impervious gloves, and safety shoes or boots to their maintenance crews. Use of hot water and soap after exposure to possible contaminated areas will aid in the control of infection.

Presence of gas hazards in sewers may result from a number of causes,[9] as follows:

1. Leaks of natural sources, such as wells.
2. Leakage of gas, gasoline, or solvents from adjacent underground structures or utilities.
3. Discharge of volatile wastes into sewers from industrial sites.
4. Accidental discharge, or spillage, of explosive materials which might reach the sewer.
5. Formation of gas from septic sewage, resulting from complete or partial stoppages and sluggish flows.

Accidents resulting from gas can be avoided by strict application and enforcement of safety regulations and by use of available equipment and safety appliances. The slightest infractions of the rules pertaining to safe operation in the presence of gas may result in injury or death to personnel, extensive damage to equipment and property, and complete loss of utility services.

The following safety rules are pertinent to operations in hazardous gas areas and are of prime importance to sewer cleaning crews:

1. Smoking, lighted matches, or open flames are prohibited in the vicinity of open manholes.
2. Tests for toxic or explosive gases, as well as oxygen deficiency, will be made in manholes and sewers prior to the time personnel are permitted to enter.
3. Personnel shall, in no case, work alone in a confined area where there is a suspicion of free gas.
4. Manholes and sewers shall be ventilated by natural or mechanical means prior to entry of personnel.

Gas safety appliances that are available for use by sewer cleaning crews include gas masks, gas detectors, combustible gas indicators, safety lamps, air blowers, and first aid kits.

Perhaps the most difficult hazard to explain in the sewer cleaning operation is oxygen deficiency. Many workmen who are untrained assume that the wearing of a gas mask provides them with protection against all hazards. Even though a municipality cannot afford air blowers or respirators, sound practice dictates that adjacent manholes be opened for some time prior to entry of personnel. Acceptance of this precaution will permit some natural circulation of air.

The matter of radiation hazard is a specialized field and will not affect too many localities. It appears that the many possibilities for use of atomic energy in the future will result in general radiation waste problems. Radiation detectors are available.

Testing apparatus and safety equipment and appliances may assume a creditable investment. There are no rules for determining the amount of safety equipment necessary for the safety of a sewer cleaning operation. Obviously, each municipality and operation will vary both as to financial ability to support an extensive program and as to the type of sewer system under study.

It should be emphasized that there are a number of "common-sense" safety practices and regulations which can be applied to personnel and which do not increase the budget of the department. Department heads should insist on strict adherence to the basic fundamentals of safety. Many municipalities are unaware of the actual dollars lost through the lack of an adequate safety program.

Actual monetary savings may be demonstrated by the savings made in workmen's compensation premiums of comparable cities with safety programs of varying intensity. Other savings may result from full-time employment of personnel without the necessity of hiring temporary manpower to replace accident losses. The intangible losses that cannot be directly ascertained are generally believed to exceed direct costs of accidents by about 500 per cent. At this rate, the financial loss developing from accidents and lack of safety programs could achieve a staggering total.

The importance of a continuing safety program should also be emphasized. New employees not only should be trained in the tasks they are to perform, but must be indoctrinated with the safety program prior to functioning in their positions. This is particularly true of employees used in the sewer maintenance and sewage treatment fields because of the attendant hazards.

Once the employee is started on his job, the safety program must not be relaxed. It appears that from 3 to 5 hours per month are spent on safety training for employees where an adequate program is in operation.[10] Strict adherence to penalties for violation of policies and directives should be followed.

Because of the serious hazards existing in sewer cleaning and maintenance work, and because of the fairly high frequency of accidents in this field, it is important that an adequate safety program be adopted in conjunction with the maintenance program.

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Atomic Power Wastes Utilized by Water & Sewage Plants

Radioactive waste products of nuclear power reactors could be used in water intake and sewage treatment plants to effect a 99 per cent reduction in harmful bacteria and at the same time lessen plant operation costs, University of Michigan research indicates.

Significantly, too, the technique would take beneficial advantage of the radioactive waste products which now have to be stored beneath the ground or elsewhere until they loose their dangerous radioactivity. Finding uses for such products presently is one of the most challenging problems concerned with the operation of nuclear power reactors.

While actual details would have to be worked out by sanitary engineers, the U-M scientists say harmful bacteria could be killed by running water or sewage past a core of radioactive waste products. This core would act similar to a huge X-ray machine, and because of the nature of the radioactive waste products and their installation, the water and material in the water would not become radioactive.

The core would remain active for several years before a replacement would be necessary. The use of this material could effect a saving in the cost of treatment of some waters, since there is some evidence that similar amounts of water treatment chemicals would be required.

Basic cost of the radioactive "waste products" would be in the handling of them between the source and the treatment center, but probably a regular schedule could be worked out to keep this at a minimum.

The research was done by Gerald M. Ridenour, professor of public health engineering, and Edward H. Armbruster, president lecturer in public health engineering. It was conducted under a grant from the Michigan Memorial-Phoenix Project and the National Sanitation Foundation.

Water Background

Modern industrial civilization thirsts for water. In 1900, the per capita daily consumption of water (amount of water used divided by number of population) was 530 gallons. In 1950, it was 1,340 gallons. By 1970, it is expected to climb to 1,947 gallons, according to the U. S. Department of Commerce's most recent projection. The greatest single use is industrial.

(PRB News Release)

"Boy, that really must have been a big line break."

Inasmuch as syndets are changing the composition and characteristics of sewage, it is desirable to know something about . . .

Synthetic Detergents

by ROSS E. McKINNY and JAMES M. SYMONS, respectively, Associate Professor and Assistant Professor, Massachusetts Institute of Technology, Cambridge, Mass.

AUTHORS' NOTE: Synthetic detergents have had a pronounced effect on sanitary engineers. Problems have developed in water purification plants, in sewage treatment plants and in streams which have seemingly defied a rational solution. Considerable information has been published in the sanitary engineering literature concerning the problems connected with the increased use of synthetic detergents, but little has been published in this field about the synthetic detergents themselves.

If synthetic detergents are the cause of problems, as many people think they are, it is necessary for persons affected by these problems to know what synthetic detergents are and why they act as they do. Only through understanding the basic chemistry of the synthetic detergents can reasonable solutions to the problems blamed on synthetic detergents be arrived at. It is the purpose of this paper to review the basic chemistry of synthetic detergents as they affect sanitary engineers.

■ SYNTHETIC DETERGENTS are more commonly referred to as syndets. They represent a class of compounds which have appeared since World War II. Synthetic detergents are not that new but development was retarded until a demand was created. The shortage of fats in World War II for soaps stimulated the search for substitutes. The substitute proved to be of greater importance than soap and created a new industry. Since World War II, syndets have almost completely replaced soaps in washing dishes and clothes in the home and in most cleansing compounds used in industry. Soap has been retained in the facial soaps, but current events point to the complete elimination of soap as a cleansing agent.

It is reasonable to expect that syndets will have replaced 98 to 99 per cent of the soaps within a period of 20 years. It is obvious that this rapid change from soaps to syndets will produce drastic changes in the nature and characteristics of sewage and receiving streams. Furthermore, to a great extent, this change has already occurred. The sanitary engineer faces the problem of significant changes in the characteristics of the waters and wastes with which he deals, and modification of his processes compensate for these syndet caused changes.

Dr. McKinney is a contributing editor of *Water & Sewage Works.*

Types of Syndets

Soap was a singular type compound, the sodium salt of a long chain aliphatic acid. The syndets which replaced soap were not a singular type compound but rather were multiple, even by the simplest classification.

Syndets fall into three broad classes:

1) anionic
2) nonionic
3) cationic

The anionic detergents ionize in water to form negatively charged molecules. The nonionic detergents do not ionize in water and the cationic detergents ionize to form positively charged molecules.

If each of the three classes of syndets contained only one compound, the syndet problem would be simplified. Such is not the case, however. Within each group there are varied chemical structures which produce different reactions. Each group of chemicals must be considered individually. The anionic syndets consists of alkyl sulfo-

nates, alkyl aryl sulfonates, sulfonated amides and amines, and sulfonated esters and ethers. The nonionic syndets include polyethylene oxide condensation with acids, alcohols, phenols, alkyl phenols, amides and amines. The cationic syndets are all based on substituted amines. Even these chemical groups represent an oversimplification of the syndet structures.

Primary Surface Active Agents

Although there are many different types of suface active agents, there are only four types of importance: (1) alkyl sulfates, (2) alkyl benzene sulfonates, (3) alkyl phenol ethylene oxides and (4) quaternary ammonium compounds. The type formulation of these compounds are shown in Fig. 1.

The alkyl sulfates resembles soap in their basic formualtions. The difference being the substitution of the sulfate group for the carboxyl group. This change in molecular structure produced a molecule with greater hydrophilic tendencies and hence greater stability. The alkyl sulfates accounted for approximately 14 per cent of the total syndet production in 1956. Most of this syndet went into washing powders and shampoos, although some went into tooth pastes.

The alkyl benzene sulfonate is most rugged and the most economical of the syndets. It is readily derived from petroleum and does not represent as pure a chemical structure as the alkyl sulfates. In fact, very little is known of the exact chemical structure of the alkyl fraction other than it is a complex mixture with an average formulation equivalent to the dodecyl radical, $C_{12}H_{25}$-. The dodecyl benzene sulfonates represented 45 per cent of the total syndet production in 1956. This syndet is widely used in dishwashing and laundering, particularly in the home.

The alkyl phenol ethylene oxides are nonionic syndets which represent the major fraction of the ethylene oxide syndets. All the nonionics represented 19 per cent of the syndet production in 1956. The alkyl phenol ethylene oxides themselves accounted for 8 per cent of the total syndet production. These syndets are used in the liquid form which is popular with housewives. Often the nonionic syndet is combined with the alkyl benzene sulfonates to produce better detergency.

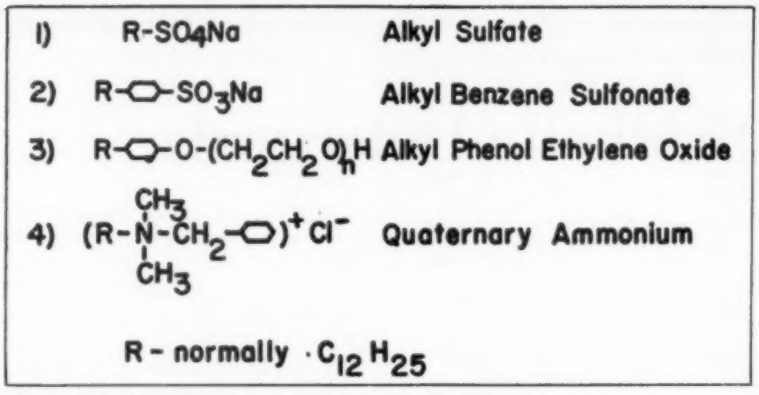
1) R-SO4Na Alkyl Sulfate
2) R-C6H4-SO3Na Alkyl Benzene Sulfonate
3) R-C6H4-O-(CH2CH2O)nH Alkyl Phenol Ethylene Oxide
4) (R-N(CH3)(CH3)-CH2-C6H5)+ Cl- Quaternary Ammonium
R - normally · C12 H25

FIG. 1—SYNDETS may be one of four type formulations.

The quaternary ammonium syndets represented only 1 per cent of the syndet production in 1956. Their importance is in their chemistry. These syndets are highly bactericidal and are used where disinfectant cleansers are required.

Builders

Syndets as purchased on the commercial market are not made up of 100 per cent surface active material but only contain from 17 to 35 per cent surfactant.[1] The remainder of the commercial syndet is made up of builders. The exact formulation of builders varies with the type and function of the detergent. Generally, the builders can include polyphosphates, silicates, carbonates, sulfates, carboxymethylcellulose and alkanolamides.[1,2]

The polyphosphates are water conditioners. They tend to tie up the metallic ions in water and prevent their precipitation. The polyphosphates also help buffer the reaction fluid to insure maximum action by the surface active agent. Silicates are also sequestering agents. Carbonates add alkalinity and raise pH for maximum ionization. Sulfates are a by-product in manufacturing the surface active agent and assist in producing a dry powder detergent. Carboxymethylcellulose prevents redeposition of dirt once it is tied up by the syndet. The alkanolamide is a foaming agent. Typical formulations of a syndet is as follows:[1]

Sodium alkyl benzene sulfonate	22—35%
Sodium polyphosphate	37—48%
Sodium silicate	5— 9%
Sodium sulfate	12—19%
Sodium carboxymethyl cellulose	0.5%

Syndet Production

At the present time syndet production appears to have leveled off at slightly over 1,000,000,000 pounds per year. Unlike the soap industry where the basic chemical formulation did not change with time, syndets are characterized by their continual change. The alkyl sulfates predominated initially but were surpassed by the alkyl benzene sulfonates. Today the nonionics are steadily rising. As chemical technology changes so will the syndets. Economics and the desires of the housewives will have considerable influence on the types of syndets produced.

Syndets curently represent 70 per cent of the total soap and syndet market. The main reason that 30 per cent of the sales are still retained by soap has been the lack of a good bar syndet to replace toilet soaps. Current research has produced a bar syndet which may take over the toilet soap market. The major ingredient in the bar syndet is an α-sulfonated tallow acid of the general formulation shown in Fig. 2. If these are successful then a new major group of syndets will appear.

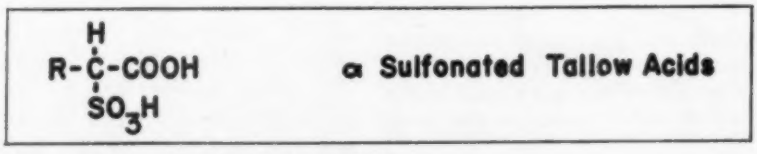

FIG. 2—BAR syndets have this formulation.

Surface Activity

Syndets are important because of their surface activity. The basic molecule of any syndet type can be divided into two general chemical groups, the hydrophilic group and the hydrophobic group. The hydrophilic groups

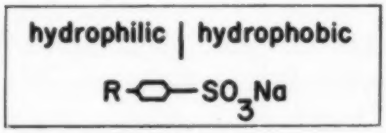

FIG. 3—THE SURFACE properties of a typical syndet molecule are indicated by this formula.

are carboxyl groups, sulfonates, amines and hydroxyl. The hydrophobic group is the alkyl group or the aryl group or a combination of both of them (see Fig. 3). Each group plays its part, the hydrophilic groups make the molecule soluble, while the hydrophobic groups attract and hold grease molecules and dirt particles.

Surface activity has been associated with surface tension. As the surface activity increases, the surface tension decreases. In pure water, 100 mg/L syndet can reduce the surface tension from 72 dynes/cm to between 37 and 48 dynes/cm.[3] The addition of 100 mg/L syndets to fresh domestic sewage from San Antonio, Texas, caused the surface tension to decrease from 38 dynes/cm to 33 dynes/cm, a negligible change in surface tension. While this reduced surface tension is important in the cleaning action of syndets it has little effect on sewage treatment processes.

Detergency

Very little is known of the mechanism of detergency. Only general concepts are known and even these concepts are often in doubt. The general concept is that the surface active agent tend to orient themselves in a definite pattern. The hydrophobic portion of the surface active agent is attracted to hydrophobic dirt and grease particles. The hydrophilic portion is oriented towards the water. This is schematically shown in Fig. 4. The dirt particle becomes coated with the syndet which transforms the dirt particle from a hydrophobic particle to a hydrophilic particle. In this way the particle is separated from the surface being cleaned and moves into the water.

Once suspended, the particle must be kept in suspension. The particles are actually of colloidal size and respond to colloidal phenomena. If syndets were composed only of the surface active agent, the dirt particles would tend to agglomerate due to Brownian movement and settle back onto the surface. One of the builders, carboxymethylcellulose, makes the dirt-surfactant colloid more hydrophilic and prevents their increase in size and therefore their redeposition on the surface being cleaned.

Old Wive's Tales

The housewife has become so indoctrinated to the fact that soap does not clean until it creates foam, i.e. is in excess, that she will not accept a non-foaming syndet for dishwashing. Non-foaming syndets have become a necessity in modern clotheswashers. While the housewife will accept a non-foaming syndet for clothes washing, she demands a high foamer for dish washing.

The synethic detergent industry has responded to the housewive's demands by creating high and low foaming syndets. A non--foaming surface active agent can be blended with a builder to make a foaming syndet. The major foaming builders are alkanolamides. The nitrogen portion of the molecule is the cause of foam. It unites with the syndet to form a tight chemical layer that does not readily rupture. This mechanism of foam stabilization is the basis of the problem of frothing in sewage treatment plants.

Sanitary Engineering

No one can deny that syndets have caused a change in the characteristics of sewage. The syndets have replaced the fatty acid salts used in soaps. This simple replacement has greatly affected sewage treatment. The sedimentation of calcium and magnesium salts of these fatty acids in the primary sedimentation tank has been eliminated. A major portion of the organics normally removed at this point has suddenly vanished. The syndets do not form insoluble calcium and magnesium salts which settle, but remain suspended with their load of dirt and grease. The secondary treatment device, therefore, receives this organic load normally removed by the primary unit.

The increased organic load on the secondary device has resulted in overloading with its attendant problems of insufficient oxygen supply and contact time for complete stabilization. Some of the syndets that are not completely degraded in secondary devices pose a problem in persistence in the treatment plant. Syndet persistence is most

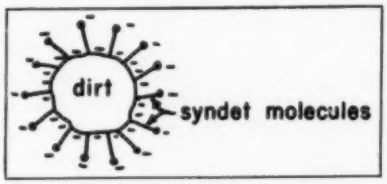

FIG. 4—THE ACTION of syndets with dirt or grease is explained by this diagram.

evident in foam formation. Combination of excess syndet with free bacterial proteins from dead microbial cells results in a strongly persistent, stable foam which causes sewage plant operators considerable trouble.

Research

The problem of syndets in sewage offers a new challenge to the sanitary engineer. The basic solution lies in a complete understanding of the effect of syndets on the microorganisms in sewage treatment systems since the elimination of syndets by sewage treatment will also prevent the problems in stream persistence and water. Research is currently progressing towards the basic reason for syndet problems in the treatment of sewage and it is expected that definite information will be available in the near future for solving the *current* syndet problem. The syndet problem will not remain stagnant, however, but rather will change as chemistry advances. The new problems which arise from new syndets will be just as taxing to sanitary engineers as the current problems are, if not more so. This is the heritage of the sanitary engineer.

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The significance of colloid systems in sewage treatment is emphasized in this study of dispersion and aggregation of . . .

Sewage Colloids

by H. HEUKELEKIAN and E. WEISBERG,*
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AUTHORS' CONCLUSIONS: This paper, one of the Journal Series of the New Jersey Agricultural Experiment Station, Rutgers University, N. J., presents a review of previous work on the subject, an outline of the experimental procedures used, and the results of the studies.

Based on the results of the experiments, the authors conclude:

1. The colloidal content of sewage increases when that sewage is subjected to the action of a Waring Blender or a centrifugal pump, but the increase in colloids is independent of blending time from 1 to 10 minutes (blending for less than 30 seconds produces less colloids).
2. The source of the increase in colloids is in the settleable solids fraction of the solids, but there is no direct relationship between the concentration of settleable solids and increase in colloids. If, however, settleable solids are added to sewage artificially, and subjected to blending action, the colloid content increases in direct proportion to the amount of settleable solids added.
3. There is no occlusion of colloidal matter in sewage by the coarser settleable solids.
4. Flocculation of colloidal matter may be accomplished by gentle shaking or stirring in 5 hours, but this flocculation depends on the presence of microorganisms. Sterile colloidal-soluble fractions of sewage (either agitated or quiescent) will not flocculate.
5. Flocculation of colloidal matter is obtained by both ultraviolet light and autoclaving treatment. Autoclaving is more effective and will result in the production of supracolloids and settleable solids from soluble solids.

The Senior Author

■ COLLOIDAL SYSTEMS ranging from hydrosols to gels are of prime importance in sewage treatment. If it is recognized that activated sludge, trickling filter sludge, primary sludge, digested sludge, chemically precipitated sludge, bacteria, and a fraction of the inorganic and organic sewage solids are colloidal systems, the significance of the statement that colloidal phenomena govern sewage purification[20] becomes readily apparent.

The colloidal fraction of sewage solids is one of the more difficult to treat. This stems from the inherent stability of colloidal systems which results from their small size, electric forces, Brownian movement, and hydration. To reduce their stability so that the colloids are more amenable to removal, one or more of their properties must be modified.

Existing methods of sewage treatment, which successfully remove colloidal matter, alter the hydration and electric forces, resulting in agglomeration or coalescence of the particles, which then are large enough to be removed by gravity sedimentation. However, most of the methods utilized are empirical and the biological and physical mechanisms relating to colloid production, dispersion, aggregation and fluocculation have not been clearly defined.

Previous Work

The colloidal fraction of sewage has attracted the interest of a number of investigators. The early investigators had as their prime objective the separation and estimation of the amount of colloids present in the sewage.[5,6,8,12] These methods consisted primarily of dialysis, filtration, and precipitation. Mills[9] in an extensive review had this to say regarding the work of these pioneer investigators: "Each writer tacitly assumed an arbitrary distinction between the suspended and the colloidal matter, but none attempted a critical study of the method of differentiation adopted in his investigations or justified the definition of 'colloidal' matter implied by the procedure used. No point is,

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Table 1
Effect of Blending on Colloidal Matter

Sewage Fraction	Total Solids, ppm Non-Blended	Blended	Change
Colloidal-soluble	410	434	+24
Soluble	359	353	—6
Colloidal	56	81	+25

therefore, served by emphasizing the quantitative aspect of the question."

Since 1920 there have been only two systematic investigations of defining and separation of sewage colloids. Mills[10] and Balmat[2] classify colloids on the basis of particle size, which is perhaps the best method of characterizing colloids. Mills' interest was primarily concerned with the occurrence and stability of the colloids as affected by such factors as pH, ionic strength, and polyvalent, monovalent, divalent and trivalent cations.

Balmat was concerned primarily with the quantity of colloids present in domestic sewage and their chemical composition. He concluded that colloids (1 μ to 1mμ) and supracolloids (non-setteable solids greater than 1 μ) represented as much as 52 per cent of the BOD and 54 per cent by weight of the suspended solids.

Other workers[13,3] have indicated values ranging from 9 to 35 per cent. Thus, the colloids and supracolloids can be seen to represent a substantial percentage of sewage solids. Their importance is further emphasized because if it is true that these solids are eliminated from sewage by mechanisms which differ from those of the settleable and dissolved solids, a knowledge of their quantity and behavior is essential to a fuller understanding of sewage treatment processes.

Theories of aggregation of sewage colloids may be divided into two schools: physical and biological. These theories refer to aggregation in the absence of biological slimes, which has been defined as flocculation. The physical theories were supported by Jones and Travis,[8] Blitz and Krohnke,[3] Williams,[17,18] and Williams and Murray.[19] The biological theories were emphasized by Fowler and Mumford,[7] and Baker.[1] None of these works has clearly defined the physical and biological roles. This was due not only to technique regarding sterility and the presence of coagulating chemicals, such as iron salts, but also to the fact that the experiments were not carried out with colloids as the sole constituents but with colloids in the presence of other sewage solids.

It is the purpose of this paper to attempt to answer the following questions:

1. What are the effects of physical factors, such as attrition, pumping, agitation, and stirring, on the quantity of sewage colloids?
2. What are the biological and physical factors concerned with colloidal flocculation?

Separation and Estimation

The method for the separation of colloids was that used by Balmat[2] and Rudolfs and Balmat.[14] In general, the procedure consisted of settling the sewage and centrifuging the supernatant liquor at 14,000 rpm, which removes particles larger than 1 μ. The centrifugate containing the colloidal and soluble fraction is then filtered under a pressure of 800 psi of nitrogen gas through a cellophane membrane, which retains particle sizes between 0.08 and 1.0 μ. This is designated as the colloidal fraction. The difference in weight of total solids between the centrifugate containing the colloidal-soluble fraction and the soluble fraction obtained after ultrafiltration is taken as the colloidal fraction.

Table 2
Changes in Sewage Fraction by Blending

Sewage Fraction	Total Solids, ppm Before Blending	After Blending	Change
Saw sewage	364	365	+ 1
Settleable*	71	25	—46
Non-settleable	293	340	+47
Colloidal-soluble	249	274	+25
Soluble	220	221	+ 1
Colloidal	29	53	+24

* Calculated value: settleable = raw sewage solids — non-settleable.

Experimental Procedures and Results

Dispersion of Solids by Waring Blender

Although sewage ordinarily is not subjected to agitation as violent as that produced by a Waring Blender, it was interesting to determine whether such agitation increases the colloidal fraction and from what particle size the increase in colloidal matter originates.

Screened raw domestic sewage was agitated in a blender at 10,000 rpm for 5 min. The temperature was maintained between 25° and 30° C by means of cold towels wrapped around the bowl of the blender. The results (Table 1) indicate an increase of 25 ppm in the colloidal solids.

To determine which fraction of the sewage was contributing to the increase, raw sewage was blended for 5 min and the solids content of each fraction before and after blending was determined (Table 2). An increase of 24 mg/L in the colloidal matter was obtained; the non-settleable fraction increased by 47 mg/L. Because there was no increase in the soluble fraction, 23 mg/L of this increase in the non-settleable fraction is attributed to supracolloidal solids. The results indicate that settleable solids contribute to the increase in colloidal solids, but possibly settleable solids are being converted to supracolloidal size and the colloidal solids are being produced from the latter.

To verify this possibility the various sewage fractions (namely the settleable, non-settleable, colloidal-soluble, and soluble fractions) were blended independently and the total and colloidal-soluble solids in each fraction were determined (Table 3).

The settleable fraction was the only one which showed an increase in the colloidal-soluble fraction upon blending. Inasmuch as none of the other fractions underwent a change upon blending, the settleable solids are apparently the source of the increase in the colloidal solids. The 6 mg/L of

Table 3
Effect of Blending Various Sewage Fractions on the Colloidal-Soluble Fraction

Sewage Fraction	Total Solids ppm	Colloidal-Soluble, ppm Before Blending	After Blending
Settleable	83	6	28
Non-settleable	247	221	221
Colloidal-soluble	221	222	221
Soluble	200	200	200

Table 4

Relationship Between Sewages of Different Settleable Solids and Colloidal Content and Increase in Colloidal Turbidity After Blending

Settleable Solids, ppm	Turbidity, ppm			
	Initial	After Blending	Increase	Increase, % sol.*
67	43	69	26	39
72	29	56	27	38
83	21	43	22	26
110	59	82	23	21
120	81	93	12	10
125	100	125	25	20
132	71	92	22	17

* As percent of settleable solids.

colloidal-soluble solids in the settleable fraction can be attributed to the liquor which could not be completely siphoned off after sedimentation. The 22 mg/L increase in colloidal solids upon blending of the settleable solids represents a 100 per cent increase of the original colloidal content. Of the settleable solids, 27 per cent were converted to colloidal solids. These statements depend on the fact as previously shown that soluble fraction is not affected by blending and that the difference between the colloidal-soluble fraction and the soluble fraction represents the colloidal fraction.

The determination of colloidal solids by centrifuging, ultrafiltration, and weighing, as previously described, was time-consuming. To expedite the procedure it was considered possible to establish a relationship between the weighed solids and turbidity in the colloidal-soluble fraction and to use the turbidity of this fraction as a measure of the amount of colloidal solids. Turbidity was measured by using the Fisher electrophotometer. On the basis of a number of such comparisons with different sewages varying from 30 to 135 mg/L of solids in the colloidal-soluble fraction, a straight-line relationship was established with a turbidity-to-weight factor of 1.1 to 1.2. In subsequent experiments, therefore, turbidity was used as a measure of colloidal matter in the centrifugate.

The effect of blending time on the dispersion of solids in sewage was studied. It was shown that blending for 0.5 min increased the turbidity by 10 mg/L and an additional 0.5 min increased it another 10 mg/L. No further increases were obtained up to 10-min blending time.

To determine the relationship between the increase in colloidal solids and settleable solids, sewages of various settleable solids and colloidal contents were studied. Table 4 shows the results from a number of sewage samples. The increase in turbidity was fairly constant, varying from 22 to 27 mg/L in all samples except one, in which it was only 12 mg/L.

The comparatively constant increase in turbidity was obtained despite the differences in the initial amount of settleable solids. Thus, the increase in turbidity expressed as a percentage of the initial suspended solids decreased with increasing initial suspended solids content in the raw sewage from 39 per cent to 10 per cent. The conversion of settleable solids to the colloidal state, therefore, seems to be independent of the settleable solids concentration.

These results were obtained from different sewages in which, presumably, the nature of the settleable solids varied as well as the concentration. Accordingly, the concentration of the settleable solids in a given sewage was artificially changed by decantation after settling and addition of varying amounts of the settled solids to the supernatant. These were then blended and the turbidities of the centrifugate determined (Table 5). Greater increases in turbidity were obtained upon blending with increasing initial settleable solids concentration. Expressed as a percentage of the initial settleable solids, the values remained fairly constant around 15 to 17 per cent.

A repeat experiment wherein the initial concentration of settleable solids was varied from 120 to 480 mg/L gave increases after 5-min blending of 16 to 21 per cent on the basis of the initial settleable solids concentration. Increasing the blending time beyond 1 min again did not increase the conversion to colloidal matter. The results of these experiments indicate that a 15 to 20 per cent fraction of the settleable solids was capable of being dispersed; and an increase in time of blending did not result in the dispersion of additional suspended solids.

In these experiments the nature of the settleable solids was kept constant, in contrast with results reported in Table 4, where with different sewage samples the conversion varied from 10 to 39 per cent, indicating that susceptibility to dispersion varies, among other things, with the nature of the settleable solids. The evidence that there is a labile portion of settleable solids that can be dispersed is based on the following observations:

1. No further dispersion with blending beyond 1 min.
2. Constant percentage of dispersion with increasing settleable solids when the character of the solids is not changed.
3. Different percentage of dispersion upon blending with different sewages.

It appears that the dispersible portion is more weakly held to the settleable solids and that it differs from the

Table 5

Effect of Artificially Changing the Settleable Solids Concentration on Turbidity After Blending

Settleable Solids, ppm	Turbidity, ppm			
	Non-Blended	Blended	Increase	Increase, % sol.*
100	53	68	15	15
200	54	85	31	15.5
300	53	99	46	16
400	53	121	68	17

* As percent of settleable solids.

rest of it in its physical properties. This dispersible portion could be (a) the partially disintegrated portions of the original settleable solids, (b) finely divided material in sewage attached to the settleable solids, or (c) separate colloidal aggregates.

To determine the possibility of settleable solids removing finely divided materials, 30 to 480 mg/L of settleable solids were added to the colloidal-soluble fraction and allowed to settle. The residual turbidity with and without settleable solids additions did not show any difference. Washing of the settleable solids with distilled water to free them from previously occluded particles prior to addition to the colloidal-soluble fraction did not remove any turbidity. It was concluded, therefore, that settleable solids do not occlude or attach colloidal materials.

Dispersion of Solids by Pumping

From a practical standpoint it was of interest to determine whether pumping results in an increase in colloidal matter.

The pump used was a laboratory model centrifugal pump with a speed of 5,000 rpm. The pumping rate was 150 ml per min. The turbidity of the colloidal-soluble fraction of the sewage before and after pumping was determined. The results from three different sewages are given in Table 6.

There were significant increases in the turbidity as a result of pumping, varying from 9 to 27 mg/L, which, expressed on the basis of initial settleable solids, amounted to 13 to 27 per cent. These values are in the same order of magnitude as those obtained with the blender.

To obtain more direct comparison between the effect of blending versus pumping on the increase in colloidal matter, the experiment was repeated with the same sewage in which the settleable solids had been artificially altered to give three different concentrations. Part of each of three prepared sewages was then blended for 5 min. in a blender, the remainder being pumped as previously described. The results (Table 7) indicate that pumping and blending produce generally similar increases in colloids. The increase in turbidity was correspondingly greater with increasing settleable solids concentration and represented a fairly constant percentage of the settleable solids.

Table 6
Effect of Pumping on Colloidal Turbidity

Settleable Solids, ppm	Turbidity, ppm		Increase, % turb.*	Increase, % sol.†
	Initial	After Pumping		
68	59	68	15	13
82	71	93	31	27
126	80	107	34	21

* As percent of initial turbidity.
† As percent of settleable solids.

Effect of Shaking

The two methods of agitation employed heretofore are rather violent. Therefore, it was considered desirable to study the effect of more gentle agitation, such as shaking. The sewage was placed in Erlenmeyer flasks and shaken in an oscillating manner on a rack. The turbidity of the centrifugate was determined before and after different periods of shaking up to 3 hr. There was no detectable difference in the turbidities between the control up to 2 hr under quiescent conditions and the shaken flask after corresponding periods. There was a slight decrease in turbidity in the control and the shaken flask during the third hour. It can be said that this method of agitation did not result in a dispersion of colloids; if anything, there was a slight tendency toward a decrease in the dispersion, with consequent decrease in turbidity. Upon repetition of the experiment, over a 24-hr period, the results for the shorter periods were confirmed and the tendency for decreasing turbidity over long periods was more clearly demonstrated (Table 8). Up to 6 hr, the decrease in turbidities was low and in the same order of magnitude in the shaken and unshaken flasks. Thereafter the shaken flasks gave greater decrease in turbidity, whereas the control flask remained constant. The decrease in turbidity cannot be attributed to mere physical aggregation and flocculation, because biological action was not precluded. The decrease in turbidity was shown not to be due to pH, because it remained unchanged during the experiment.

To more clearly define the physical and biological factors it was necessary to work with sterile sewage, sterilized by means of ultraviolet light. The rate of flow was adjusted to give a sterile effluent, which was determined by actual plating on nutrient agar. Sterile conditions were also maintained during the period of shaking. Table 9, showing the effect on colloidal turbidity of shaking sterile and non-sterile sewage, indicates that there were significant reductions in colloidal turbidity only in the shaken non-sterile sewage. The initial decrease in the turbidity of the sterilized sample possibly may be attributed to the denaturation and coagulation of the proteins.

Shaking apparently causes a decrease rather than an increase in colloidal matter. The shaking employed in those tests was not of sufficient

Table 7
Effect of Pumping and Blending on Colloidal Turbidity

Setleable Solids, ppm	Turbidity, ppm			Increase, % turb.*	Increase, % sol.†
	Before Treatment	After Treatment	Increase		
		(a) BLENDED			
111	76	100	24	37	22
222	76	118	42	55	19
333	75	131	56	75	17
		(b) PUMPED			
111	76	92	16	21	19
222	76	113	37	49	17
333	76	129	53	70	16

* As percent of initial turbidity.
† As percent of settleable solids.

severity to disintegrate the coarser solids or to emulsify or stabilize the colloids as blending and pumping did. Reductions in turbidity were evident only in non-sterile sewage after shaking for considerable time (5 to 6 hr). These observations would tend to indicate that the reductions in turbidity by shaking were the result of biological action. Shaking increases the agglomeration of colloidal matter by increasing the chances of contact and by providing more oxygen than quiescent conditions.

Effect of Stirring

To determine the effect of more gentle agitation than shaking, stirring in a laboratory mechanical flocculator was tried. The stirring rate was 30 rpm. After different periods of stirring, aliquots were withdrawn, settled and centrifuged. The turbidity of the colloidal-soluble fraction was determined. The results were similar to those obtained by shaking; namely, (a) very little reduction in turbidity with short periods of stirring (5 to 6 hr), (b) significant reductions over longer periods of stirring in the non-sterile samples, but low reductions in the sterile sewage.

Effect of Autoclaving

To determine the effect of heat on the aggregation or dispersion of sewage colloids, sewage was autoclaved at 120° C for 15 min. The results are given in Table 10. Autoclaving gave marked changes of the sewage constituents. It increased the colloidal-soluble turbidity from 80 to 140 mg/L, and upon recentrifuging the autoclaved sewage the turbidity decreased to 50 ppm. Coagulation upon heating seems to be responsible for the increase in turbidity due to the production of supracolloidal matter, which is removed by centrifuging to give a lower final turbidity than in the original sewage.

The supracolloidal matter produced upon heating must originate from materials which did not contribute to turbidity of the sewage; namely, the soluble materials. To confirm this possibility the soluble fraction of sewage was autoclaved. The results (Table 11) show that there is a marked increase in turbidity after autoclaving the soluble fraction. It appears to be a conversion of the soluble matter to supracolloidal rather than to colloidal, as it could be removed by centrifuging.

Table 8
Turbidity Reduction by Shaking

Time, hr	Turbidity, ppm	
	Control	Shaken
0	62	----
1	62	62
2	60	60
6	58	57
8	58	50
24	56	35

Discussion

The results of the experiments concerned with various types of agitation ranging from the blender to gentle stirring indicated that the colloidal content of sewage may be increased or decreased, depending on the severity of the treatment. The increases obtained with the blender and pumping were believed to be due to a combination of actual disintegration of larger particles to colloidal solids by the mechanical and hydraulic shearing forces, and to the emulsifying stabilizing action of the blender and the pump on weakly-bonded settleable colloidal aggregates. The contribution of these two factors to the increases in the colloidal matter depends on the character of the sewage solids and varies in any particular sewage.

There was no relationship between the settleable solids concentration of a sewage and the amount of colloids which could be produced. This suggests that the production of colloids depends on the nature of the settleable solids, the proportion of solids susceptible to disintegration, and the proportion of aggregated colloids. The dispersion of the aggregated colloids present in the settleable solids was explained on the basis of emulsification, because this is a property common to both a blender and a centrifugal pump.

Table 9
Effect of Shaking Sterile and Non-Sterile Sewage on Collidal Turbidity

Time, hr	Turbidity, ppm			
	Non-Sterile		Sterile	
	Control	Shaken	Control	Shaken
0	93	----	82	----
1	92	90	82	83
2	91	88	80	82
5	88	86	79	82
10	88	75	77	80
24	87	48	76	79

The particles which settle out from the sewage more than likely are the hydrophobic colloids that are close to their isoelectric point. Under these conditions, they would be very unstable. Because the colloids in sewage represent a diverse, complex group, consisting of organic, inorganic, lyophobic, and lyophilic particles representative of carboyhdrates, proteins, and fatty acids, it is not surprising that some of these particles in the sewage at any one time and under a certain set of environmental conditions would be in an unstable state.

Mills[11] has given ample evidence of the changes in colloidal stability with varying ionic concentrations of neutral salts and pH. He considers that the colloidal particles settled out under these conditions are settling aggregates of colloids which can be redispersed upon agitation. If the action of the blender and the centrifugal pump was merely a redispersion, there would be no resultant increase in the colloidal particles, because they would tend to re-aggregate and settle out again.

It is evident that the blended particles were in a more stable state than the unblended. The origin of the stability is believed to be due to an emulsification of the particles by this type of agitation.

Although the discussion up to this point has emphasized the instability of the colloids, there is evidence that a portion of the colloids is very stable. This is borne out by the fact that increasing quantities of settleable solids do not cause increased removals of colloidal matter. This indicates that the removal of sewage colloids involves more than a "sweeping out" or entrainment while they are in a stable state. The charge and hydration of these colloids maintain them in suspension regardless of the suspended solid concentration.

Wiegner[16] has studied the effect of coagulation on the removal of colloidal particles and termed that removal which is due to the presence of settling aggregates as "orthokinetic"

coagulation. But this type of coagulation is most operative with both discharged and dehydrated particles. This work, and that of Williams,[18] confirms the fact that the presence of settling particles does not affect the settling of stable sewage colloids.

If the severity of agitation is reduced to that obtained by shaking, there is no increase in colloidal matter. This indicates that this type of agitation is not sufficient in force to cause emulsification. The colloidal matter was not significantly changed during 5 hr of shaking. Similar results were obtained with gentle stirring. These observations lend support to the view that the sewage colloids are indeed stable, and that they are not caused to agglomerate or flocculate into particles large enough to be removed by mere physical contact.

With increasing periods of agitation, there were significant decreases in the colloidal matter when non-sterile sewage was employed. In all cases, there was a visible growth of floc coincident with those reductions. Agitation of sterile samples did not result in colloidal reductions. These observations tend to favor the biological theory of colloid removal, because in the absence of biological life there was no removal. These results are in accordance with those of Baker[1] and Stone,[15] but appear contradictory to the conclusions of Williams[17,18] and Williams and Murray.[19]

Williams did state, however, that the removals with sterile sewage were less than those with non-sterile sewage; but it should be emphasized that in none of his experiments was there complete sterility. He was able to plate out bacteria on nutrient agar from his ultraviolet-sterilized samles. The experiments described here showed no bacterial growth. This may be an important aspect which might account for the differences.

From a strictly colloidal viewpoint, collision should not result in agglomeration of stable, lyophilic sols. The charge and hydration of these particles are sufficient to maintain them in suspension. Suspensions would tend to agglomerate under conditions of agitation, or even under quiescent conditions, due to the thermal activity of the particles.[4] This "self-flocculation" was noted in these studies, because even the controls, which were kept under quiescent conditions, usually showed some decrease in the colloidal content. Williams also found this to be true.

Table 10
Effect of Autoclaving on Sewage Colloids

Fraction	Colloidal-Soluble Turbidity, ppm
Not autoclaved	80
Autoclaved, not recentrifuged	140
Autoclaved, recentrifuged	50

In the instances where there was flocculation of colloidal matter, it was not evident until after 5 hr. This tends to indicate that the physical action of stirring was not the dominant factor in colloidal removal. If it were, the effect certainly should have been noticeable prior to 5 hr. This observation not only lends support to the biological theory of flocculation, but in addition indicates that there is a lag before the biological factors become operative. This could mean that a certain type or group of organisms is necessary for colloidal flocculation.

From the standpoint of actual plant operation, the general conclusion to be drawn from these results is that the quantity of sewage sols would not be materially influenced by such factors as sewer velocities, sudden changes in sewer elevations, or pretreatment such as preaeration or preflocculation of less than 5-hr duration. These results indicate, however, that pumping would result in an increase in the colloidal content of the sewage. Thus, a pumped sewage would contain more colloidal matter after primary sedimentation than one which was not pumped, irrespective of the suspended solids concentration.

If the interpretation of the results concerning the source of the increase in colloidal matter in the blender and the pump is correct, then during primary sedimentation weakly-bonded colloidal aggregates are deposited along with the larger particles. The greatest percentage of this type of colloidal removal occurs during the first hour of settling, because subsequent settling time, as evidenced by the results of quiescent conditions, results in only a very small deposition over a 24-hr period. The inference here is that if it were possible to distinguish the suspended matter from settleable colloidal aggregates of a raw sewage, the colloidal content would be increased and the settleable solids would be decreased by approximately that obtained by the blender and the pump. In other words, the colloidal content of a sewage determined after removal of the settleable matter is less than the "true" colloidal content by the amount settled out. This potential source of colloidal matter was shown to be unaffected by violent shaking; it was not stabilized by this process.

Table 11
Effect of Autoclaving on the Soluble Fraction of Sewage

Fraction	Turbidity, ppm
Soluble, control	5
Soluble, autoclaved	72
Soluble, autoclaved, settled 1 hr.	55
Soluble, autoclaved, recentrifuged	8

Although there is evidence in the literature that preflocculation and preaeration does result in increased suspended solid removal, the results of these studies indicate that this increase cannot be attributed to colloidal matter. Only after 5-hr of agitation or stirring is there any indication of colloidal flocculation in the presence of biological life. This attests to the stability of sewage colloid systems as opposed to the relatively unstable, suspended group. Because these experiments were conducted with one sewage source with not too much variation in the colloidal content, it was not possible to statistically evaluate the relative properties of the stable and unstable sewage colloids.

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Pickups from Purdue's Sanitary Engineering News

Edited by Don E. Bloodgood

Liquid ferrous sulfate, a waste from steel mills, is being used to coagulate water at the Chicago So. District Filtration Plant.

Aluminum chlorohydrates is being used to condition sludges prior to vacuum filtration in England. Periods of operation of the filter coincide with the life of the nylon cloth, 4 months.

Thirty-five State Boards of Health use "Tentative Standards for Sewage Works" as a guide.

"A possible scheme for the economic rejuvention of the Wabash Valley Region is the development of its water resources through the construction of dams and the formation of reservoirs (or lakes) in the main valley of the river, as well as on its tributaries."

—W. E. Howland and M. B. Scott

The molecular filter membrane technique with dehydrated nutrient pads are applicable to the bacterial assay of raw settled sewage and the results are comparable to those from confirmed MPN procedures.

When a tubercle of rust in a water main forms a dense outer envelope of ferric hydroxide becomes evident. The inner anodic portion, which is undergoing corrosion may become decidedly acid. Baylis has observed that the soluble portion of such rust tubercles has a pH of 4 or 5. This may cause increased corrosion with the evolution of hydrogen gas, acceorating still further the rate of pitting.

Inhibition of corrosion of galvanized piping carrying potable water by continuous introduction of small amounts of sodium silicate (an average of 8 mg/L SiO_2) has been successfully carried on for 30 years.

The Ohio River Valley Water Sanitation Commission reports 1431 industries in the Ohio Basin that discharge wastes directly to streams. Of this number 717 provide adequate control.

Hydrogen sulfide and other sulfides can be determined in the part per billion range in air if the air is bubbled through an absorption mixture of an alkaline suspension of cadmium hydroxide contained in a Greenburg-Smith impinger.

Sodium metaphosphate glass is used in the treatment of municipal water supplies for calcium carbonate stabilization, iron and manganese stabilization, corrosion control, and well rehabilitation.

Revenue agents recently investigated a family firm after a large sum showed up on its books for "water purification" experiments. They found the money was used to build a swimming pool near the family's summer home.

A New England Committee's Recommendation for Minimum Annual Starting Salaries for Sewage Plant Personnel:

Plant Classification (Grade)	*Salary*	
	Supt.	*Operator*
I	$ 3,900	$3,900
II	4,400	4,100
III	5,100	4,300
IV	6,100	4,600
V	7,200	5,000
VI	8,500	5,400
VII	10,500	6,100

A knowledge of meters and their characteristics is essential for the water works operator who wants to select the best size meter for his specfic installation.

The sanitary engineer bridges the gap between scientific knowledge of disease prevention and practical engineering application.

Depending on the number and type of analyses made, the yearly cost of operating a monitor station for river water analysis can vary from $1,000 to $3,700.

ENLARGED Arlington County, Va., sewage treatment plant employs gas recirculation for improving . . .

Digester Net Effective Capacity

by LEONARD L. LANGFORD, Eastern Sales Manager, Pacific Flush Tank Co., Port Chester, N. Y.

AUTHOR'S RESUME: The net effective capacity of a sludge digester is defined here as "the gross volume less that volume occupied by mineral deposition on the bottom, nominal trash accumulation at the top and the zones of sludge liquor in the upper part and concentrating sludge in the lower part." Net effective capacity is the most important cubage in a sludge digestion tank.

The prevention of scum or top sludge formations will avoid the loss of net effective digester capacity from that cause. There are several methods of preventing the development of such undesirable accumulations at the top of the digester.

At Arlington County treatment plant in Virginia, where scum layers of 4 to 12 ft in depth interfered with operation, an installation of the PFT-PEARTH Process of gas recirculation was effective in restoring normal conditions in a short time. This article deals with the experience at Arlington County and the principles of the process used there; it does not deal with any other method of accomplishing scum knockdown.

■ IN CONNECTION with the innocuous reduction of volatile, water borne solids, inimical to man's welfare, consideration should be given to a means of efficient biological reduction of such disease-ridden solids. These solids are derived from nature and require reduction in volume, as well as in putrescence, whether they are to be returned to the soil, the ocean, or the

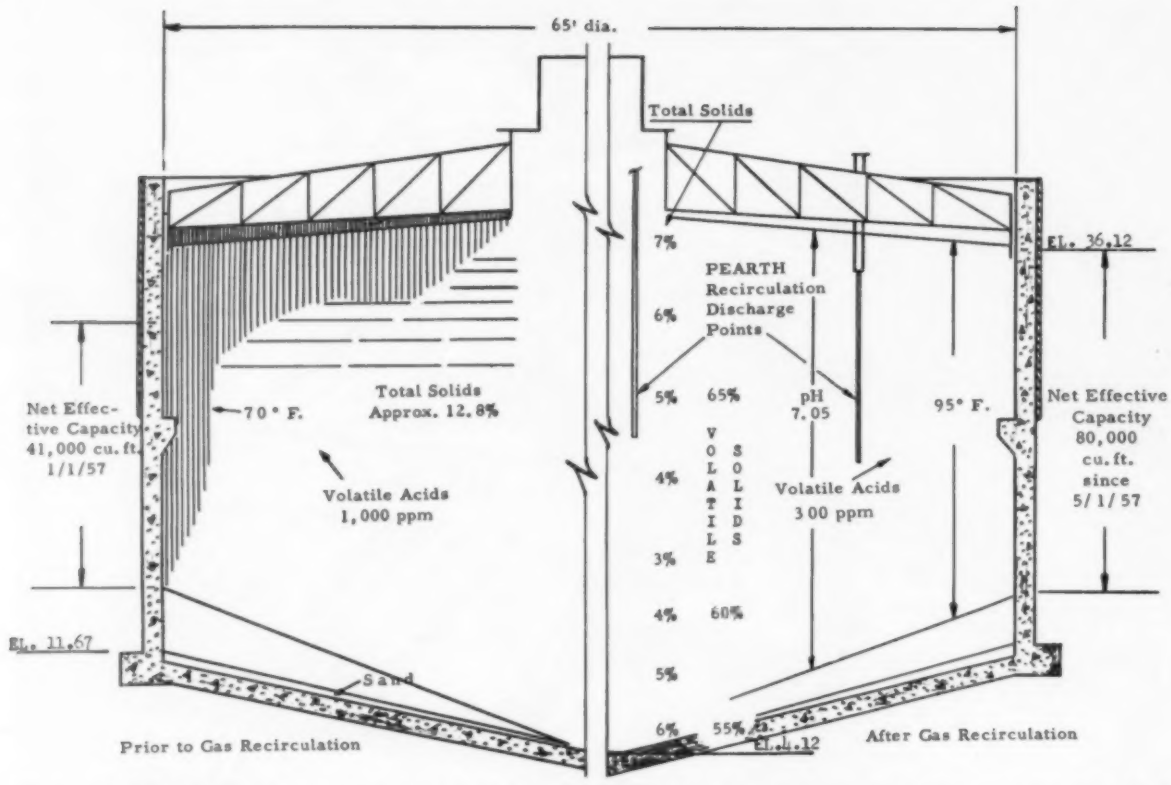


FIG. 1—CONDITIONS in primary digester No. 1 at Arlington County, Va. prior to gas recirculation are shown on the left (Jan. 1, 1957) and after gas recirculation four months later (May 1, 1957).

atmosphere. More specifically, consider facilities providing both a safe and flexible means for efficient anaerobic digestion of those solids susceptible to ready volatilization.

Flexibility vs Capacity

Flexibility of operation can readily be obtained by designing so as to allow for the use of any one, or all, digestion units as either primary or secondary digesters.

Equipping all tanks with floating covers or floating cover gas holders allows for substantial change in tank volume without circumventing the desirability of collecting and storing the gases of digestion under a constant positive pressure.

Capacity of digester is also of importance. But flexibility of tank volume is not to be confused with variability of tank capacity. Capacity can mean several things to several people. To the taxpayer, it can only mean the total volume for which he has to pay, or the so-called gross capacity.

Unfortunately, after some period of operation, because of mineral deposition on the bottom and a nominal trash accumulation at the top, only a portion of the total volume remains useful. This remaining portion is here referred to as the net capacity.

Further reduction of the initial or total volume is caused by the establishment of zones of sludge liquor in the upper and of concentrating sludge —buffer material—in a lower zone. This may be a normal condition in any tank. The remaining volume is here referred to as the net effective capacity. It is the most important cubage in any digester.

That the net effective capacity in any given tank is of fluctuating volume on a day-to-day basis is recognized. However, whenever the gross capacity is unreasonably reduced, because of retention of undue accumulations of sand or trash, the net capacity is adversely affected.

Likewise, whenever the net capacity is unreasonably reduced by the retention of an excess volume of supernatant and/or digested sludge, the net effective capacity is affected. Further, when the net effective capacity is reduced because of an accumulation of top or side sludge (scum), the entire digestion process may be thrown seriously out of control.

Top sludge, resulting from toxic or indigestible materials, creates an environment of relative dryness and reduced temperature not conducive to maximum bacterial activity.

Efficiency

Efficiency of digester operation, assuming adequacy of the heating facilities, can be maintained only by having complete homogeneity of the net effective capacity. A homogeneous mass will not allow for thermal stratification and trash accumulation.

Although sludge liquor circulation by pumping has been used with limited effectiveness, it is now recognized that supplemental multi-point gas recirculation is conducive to increased efficiency by eliminating gravitational stratification above the point of desired concentration of digested material.

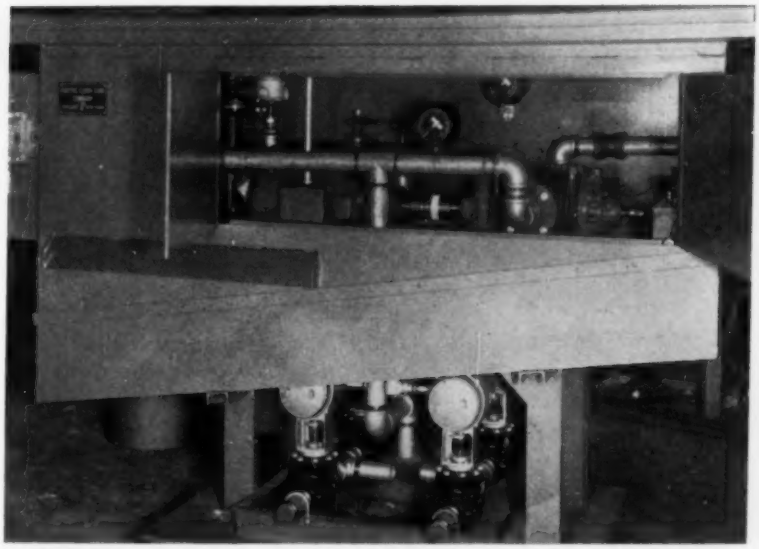
Many operators who have the benefit of floating covers report the absence of any appreciable scum accumulation. However, these fortunate ones are possibly enjoying, to some degree,

the advantages of the reaction of the air-lift principle, as the result of having a high rate of gas production per square foot of tank area.

Pearth Gas Recirculation

One of the latest contributions to the problem of reduced net effective capacity (that is, scum control) has been (a) recognizing the merit of using the air-lift principle of gas recirculation as developed by Fuhrman and associates at the Blue Plains sewage treatment plant, Washington, D. C., and (b) development of successful means for its economical accomplishment.

In 1948, at the Blue Plains plant, by means of injecting compressed sludge gas under the scum layer and into the underlying liquid zone, dispersion of a scum cap of better than 15 per cent solids, and more than 8 ft in depth, continued to a point "so that no cap as such could be measured." This point was reached after application of the Pearth process for 85 per cent of a 26-day period, with gas recirculation rate of approximately 90 cfm, in an 84-ft diameter tank with fixed cover.



MECHANICAL equipment and insulated control box used in gas recirculation process at Arlington County, Va.

Arlington Application

During 1957, the "PFT-Pearth" process, employed at the Arlington County, Va., plant, not only dissipated a top sludge blanket of 12 per cent solids and 12-ft depth, but also for about 9 months, this multipoint gas recirculation system was used to effectively homogenize the entire 30-ft depth of the digester contents.

This illustrates the flexibility of multipoint gas recirculation. In the case of Arlington County, necessity demanded that a single primary digester handle a raw solids imput of about 0.244 lb of volatile dry solids

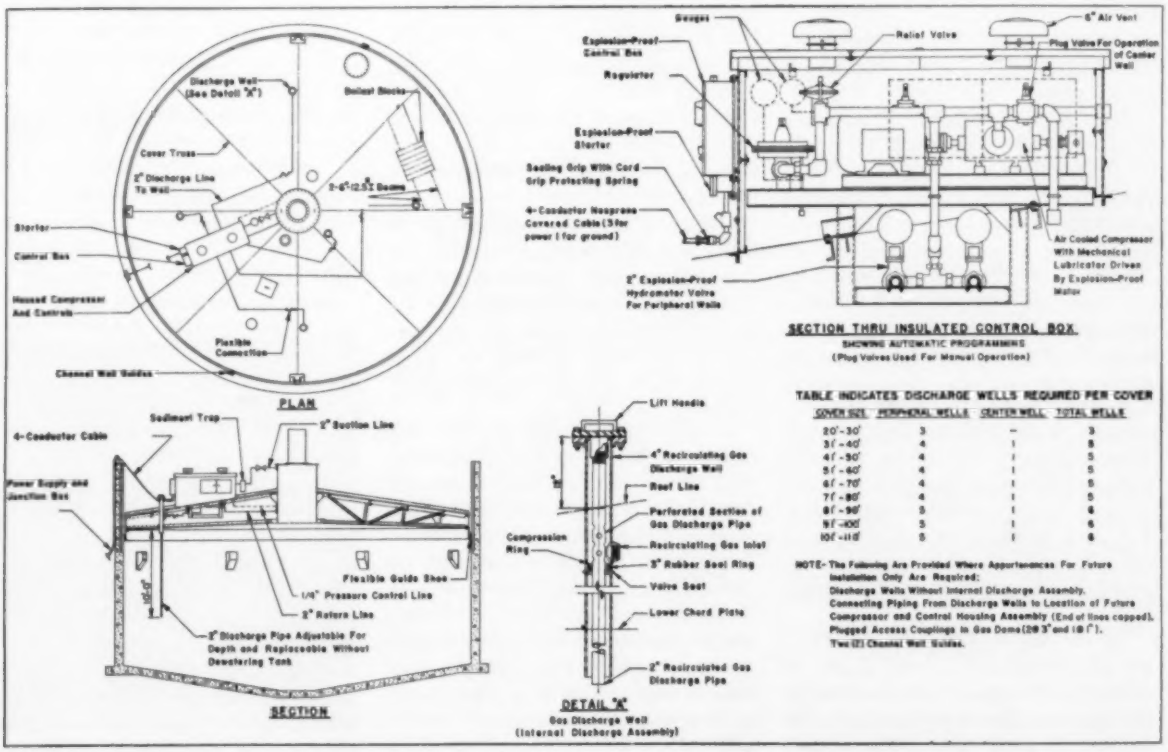
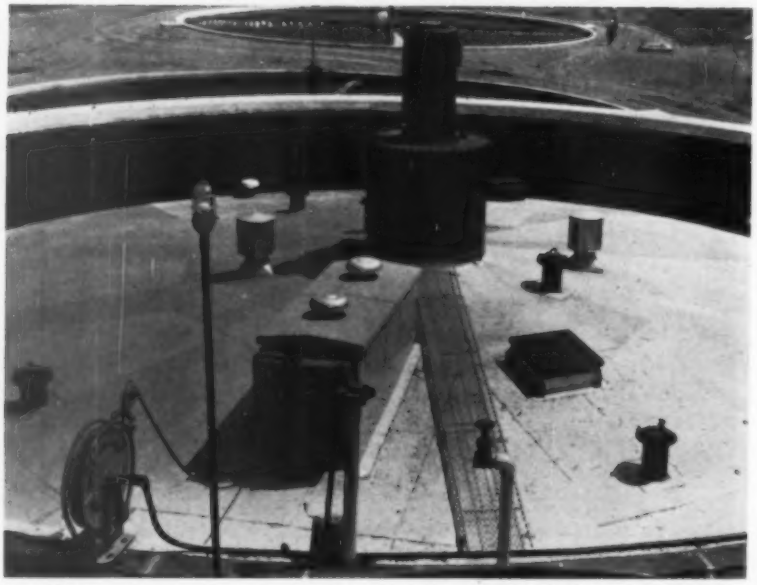

PLAN
SECTION
SECTION THRU INSULATED CONTROL BOX
SHOWING AUTOMATIC PROGRAMMING
(Plug Valves Used For Manual Operation)
DETAIL "K"
Gas Discharge Well
(Internal Discharge Assembly)
TABLE INDICATES DISCHARGE WELLS REQUIRED PER COVER
COVER SIZE | PERIPHERAL WELLS | CENTER WELL | TOTAL WELLS
20'-30' | 3 | – | 3
31'-40' | 4 | 1 | 5
41'-50' | 4 | 1 | 5
51'-60' | 4 | 1 | 5
61'-70' | 4 | 1 | 5
71'-80' | 4 | 1 | 5
81'-90' | 5 | 1 | 6
91'-100' | 5 | 1 | 6
101'-110' | 5 | 1 | 6
NOTE- The Following Are Provided Where Appurtenances For Future Installation Only Are Required:
Discharge Wells Without Internal Discharge Assembly.
Connecting Piping From Discharge Wells to Location of Future Compressor and Control Housing Assembly (End of lines capped).
Plugged Access Couplings in Gas Dome(2@3" and 1@1").
Two (2) Channel Wall Guides.

FIG. 2—General details of the PFT-PEARTH gas recirculation system installed in Arlington County, Va.



LOCATION of control box on floating cover is indicated by this photograph of an installation at the Pimmit Run Plant in Fairfax County, Va.

per cubic foot of net effective capacity per day. The Pearth process was therefore operated accordingly, resulting in a volatile solids reduction of better than 66 per cent in less than 15 days detention in the primary digester only.

The plant, involving primary treatment and serving an area adjacent to the nation's capitol, was enlarged from the original 1937 design capacity of 5 mgd to a 20-mgd capacity in 1953.

Both the two new 65-ft diameter primary digesters, as well as the original 50-ft digesters, which were converted to secondaries, were equipped with PFT floating covers. These four tanks have a combined capacity of 278,900 cu ft. Despite occasional difficulty resulting from inhibitory wastes, these tanks operated quite satisfactorily during the first two years of service.

By the fall of 1955, the net effective capacity of the primary digesters had been drastically reduced by an accumulation of top sludge. This material of about 12 per cent solids varied from 4 ft deep in the center to 9 deep at the side wall. This blanket was composed of grease, oil, hair, and stringy rags.

By the fall of 1956, the weight of the blanket had fractured piping in both primary tanks. Also, by blocking off the recirculation suction point, the external heating system for digester No. 1 was rendered useless.

Digester efficiency was reduced to 63 per cent, on the basis of actual gas production, and emergency measures were required to maintain a bacteriological sound condition in the tank.

On January 24, 1957, with gas production less than 50 per cent of normal, and tank temperature down to about 70° F, operation of the PFT-Pearth gas recirculation process was initiated, although limited to the use of available openings in the cover, affecting only about 85 per cent of the area. By this date, the top sludge depth averaged 12 ft.

Within 7 days the heating system was restored to service. The blanket was substantially shaken down and broken up. After 16 days, digester temperature was 76° F, interior piping was no longer menaced, and about 39,000 cu ft of capacity were made useful.

In less than 30 days digester efficiency, in terms of gas production, was nearly 100 per cent; within 60 days a tank temperature of 89° F was attained. The sludge blanket had been substantially eliminated and the trash accumulation became dispersed.

For about 80 per cent of each day, sludge gas was discharged manually at the rate of 150 cfm through one or two of four discharge pipes. Except at the center, gas was discharged about 15 ft below the current elevation of the floating cover.

The homogenous condition of about 88 per cent of the gross volume of 88,000 cu ft is indicated in Figure 1, which illustrates conditions before and after gas recirculation. The average pH value of 7.05, as well as the range of volatile acids from 250 to 350 ppm, has been very constant.

Since May 1, 1957, about 11,000 gal of 4.5 per cent sludge have been fed to primary digester No. 1 daily, on a 4-hr schedule. Thus, 24,770 lb of suspended solids is fed, averaging about 0.126 lb per capita. Volatile matter in the raw sludge averages about 79 per cent or 0.10 lb per capita.

Bottom material, transferred frequently to a secondary digester, contains 50 to 55 per cent solids. This reduction of better than 66 per cent is obtained in about 12 days.

During the fiscal year 1954-5, gas production from each primary digester averaged 79,000 cu ft per day.

Present gas production from primary digester No. 1 is conservatively in excess of 160,000 cu ft per day, but cannot be measured accurately on account of meter limitations.

Raw solids input to digester No. 1 for the past seven months is reported to be 19,568 lb of volatile solids in 80,000 cu ft of used net effective capacity, or 0.244 lb of volatile dry solids per cubic foot per day.

Not only is the material drawn from the bottom of the tank well-digested, but also, because the Pearth process allows for gravitational stratification at the bottom, solids transferred to the secondary digesters average about 7 per cent total solids.

Other Advantages

Installation and use of this process will rejuvenate old digesters whose usefulness has become impaired by an accumulation of cold debris. The adaptibility of the system is illustrated by 50 other operating installations, where the maintenance of maximum net effective capacity, rather than high-rate digestion, is the principle requirement.

In new digesters, where adequacy of normal (natural) gas circulation cannot be foretold with certainty, multi-point gas recirculation offers, perhaps, the cheapest form of digester efficiency insurance. To facilitate obtaining such results, a compact compressor and safety relief equipment arrangement of explosion-proof de-

sign, suitably housed, has been developed (Fig. 2). Discharge well shells are designed to permit inspection or adjustment of the gas discharge lines.

Simplicity

Use of the process results in complete mixing of whatever portion of a tank it is desired to activate. The process does not require oversize gas domes; neither are porous mediums, submerged in heavy bottom sludge, necessary. There are no moving parts within the digester and the process provides safety with flexibility.

True, the theory of the air lift as a dredge pump is involved, with considerations of submergence, bubble bouyancy, expansion and slippage, as well as the specific gravity of the mixed gas and water.

Operation

Operation of the process is extremely simple. Because jets of hot, seeded sludge liquor are used in the form of hydraulicking (hydraulic mining), gas discharge pipes need only extend into the supernatant liquor layer, under the scum layer. Unless it is desired to do so, the concentrating bottom material need not be disturbed. In normal operation, power requirements are thereby reduced to the minimum.

The multiple points of application may be altered automatically or manually. Compression of gas may be required for 5 to 90 per cent of the time, as conditions dictate.

Capacity Requirements

For many years it has been generally agreed that 1 cu ft per capita was all that was required for digestion, not including the additional volume for supernatant, trash, sludge storage, and sand. This was on the basis of a plant receiving from 0.15 to 0.20 lb of total dry solids, or 0.063 to 0.084 lb volatile dry solids, per capita per day to the digester, depending on the percentage removal and other factors.

Today, with home garbage grinders and a higher standard of living, per capita removals of 0.126 to 0.168 lb volatile dry solids to the digester per day are not unusual. Even if the contribution were at the rate of 0.20 lb of volatile dry solids per capita per day to the digester, or more, it could be handled readily in an efficiently operated tank.

Referring to digestion in terms of 0.14 to 0.20 lb of volatile solids per cubic foot per day, or 1 cu ft per capita per day, amounts to the same thing.

In addition to the 1 cu ft per capita for net effective capacity, there must, of course, be added such additional volume as will be needed under the most severe conditions for supernatant liquor, for ample buffer material, and for sludge storage. This will depend largely on the method to be employed for final disposition of the sludge. Above all, there must be provided sufficient gross volume to balance uncontrollable field limitations, such as power outages, interruption of digested sludge disposal, and personnel problems, without jeopardizing a high solids reduction efficiency.

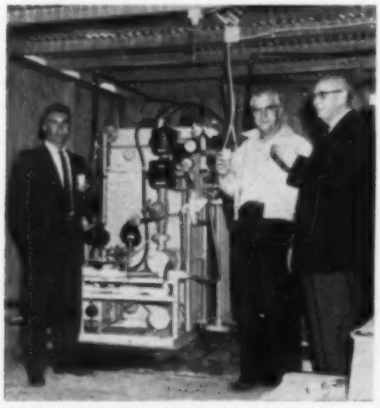
Summary

Thermal stratification frequently reduces the net effective capacity of a digester. Top and/or side sludge accumulations of reduced temperature and undesirable dryness cannot always be controlled by natural gas circulation, or by sludge liquor recirculation. Within the framework of the capacity requirements of the various state regulatory bodies, digester operation, with the tool of multi-point gas recirculation, will no longer be the difficult problem that it has been in the past. The net effective capacity can more nearly equal the capitalized gross capacity.

First Water Desalting Plant for U. S. City

The first water desalting plant to serve a U. S. city has been approved by unanimous vote of the City Council of Coalinga, California.

This city of 6,000, in the San Joaquin Valley, has always had plenty of well water, but it was too salty to drink. Since about 1900 the city has been hauling in fresh soft water 45 miles by rail. Last year the city's water freight bill was over $43,000 for a supply of about 17,000 gpd.



CITY COUNCILMEN inspecting demonstration desalter.

The new 28,000 gpd electric membrane plant, built by Ionics, Cambridge, Mass., will be installed late this year to furnish the city's separately distributed drinking and cooking water. The electric membrane plant electrically removes excess minerals from the brackish well water. It relies on an electrical current which passes through the salty water and removes the stomic-size salt ions. Then a special plastic membrane allows the salt to pass through but retains the desalted water. The desalted water is pumped to a water tower for distribution and the salts removed are flushed away as a weak brine.

The council's action followed a 2-month demonstration, and they expect to save $400,000 in the next 10 years by installation of the unit.

Manual on Industrial Water STP 148-C

The American Society for Testing Materials has published the fourth printing of the Manual on Industrial Water. In this printing, the first eight chapters, comprising the discussion are essentially unchanged from the first printing but the standards section has been greatly expanded. There are 23 new methods of testing and revisions of many existing methods; a complete Table of Contents and a detailed index have been incorporated into the Manual.

The book is priced at $7.50 ($6.00 for members) and may be obtained from ASTM, 1916 Race St., Philadelphia 3, Pa.

Much of the confusion in terminology is cleared up by this discussion of the meaning of the term . . .

High-Rate Sewage Treatment

by D. W. RYCKMAN and E. EDGERLEY, JR., respectively Assoc. Prof. and Asst. Prof. of Sanitary Engineering, Washington University, St. Louis, Mo.

AUTHORS' RESUME: In today's welter of engineering terms, there appears to be considerable question as to what is meant by the term, "high rate sewage treatment." The phrase has been used to express a variety of ideas and processes. In an effort to unscramble the meaning, consideration has been given to the fundamentals of the various "high rate" aerobic processes of activated sludge, trickling filters, and high-rate package plants. Among the factors considered are the basic principles, characteristics of the processes, rates of oxygen utilization, advantages and disadvantages of the different processes. Anaerobic processes are not included in this discussion. This article was presented before the Missouri Water and Sewage Conference and was released for publication here.

From this study, it is concluded that:

1. The term "high-rate" as used in aerobic sewage treatment has two basic meanings: (a) As applied to activated sludge, it means maintaining the microorganisms primarily in the logarithmic growth phase; (b) as appled to trickling filters it means a high rate of hydraulic loading and a high rate of biological activity.

2. Package treatment units may employ either high or low rate treatment methods, depending on operating conditions.

■ THE TERM "high rate" has been used to describe activated sludge treatment processes, filtration of sewage, clarifying units, sludge digestion methods, and patented processes.

To make the situation worse, "high-rate" is also a well-known term to describe methods of water purification. When one sees the caption "High-Rate Filter Performance," he cannot be sure whether it pertains to methods of sewage treatment or to water purification.

Review of the fundamentals involved in the so-called "high-rate sewage processes," should greatly simplify the problem, and perhaps show that the phrase, "There is nothing new under the sun," fits the situation. Therefore, a study of the fundamentals of the various high-rate sewage treatment processes is presented, but the discussion is limited to the aerobic processes of high-rate activated sludge, high-rate trickling filters, and so-called high-rate package units.

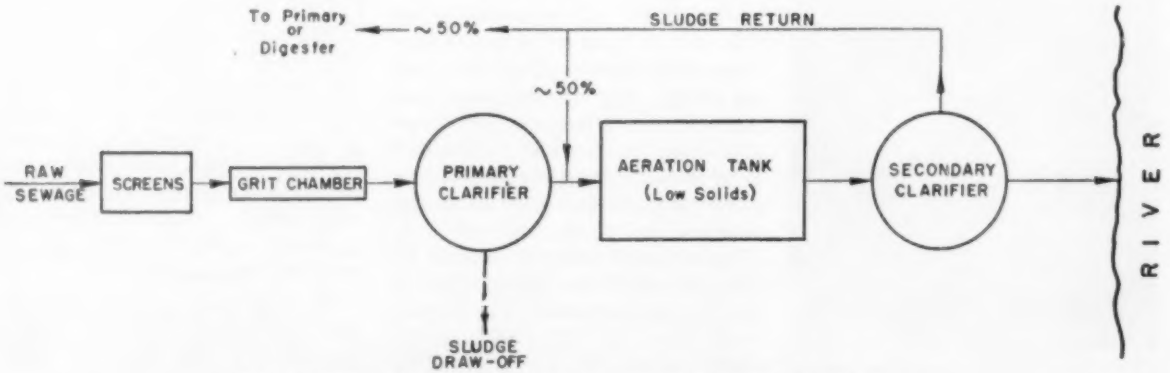


FIG. 1—HIGH RATE activated sluge process follows this flow diagram.

High-Rate Activated Sludge

A schematic flow diagram for high-rate activated sludge systems is presented in Figure 1. It should be noted that the basic flow diagram is the same as that for the conventional activated sludge process. However, considerably less sludge is returned to the aeration tank. This accounts for the lower suspended solids content maintained in the aeration tank, one of the main characteristics of the high-rate activated sludge process.

The aeration solids employed for treating domestic sewage range from 250 to 700 mg/L suspended solids, approximately 5 to 10 per cent return sludge on total flow basis. B.O.D. removals of from 57 to 76 per cent have been reported by Torpey[1] and a 2½ to 3 = detention period is used in the aeration basins. With a short detention period and low suspended solids content, the ratio of food concentration to microorganisms is very high, thus the rate of biological activity is very high. With this relatively high food concentration the microorganisms carry quite a bit of food with them to the final clarifiers, which results in an active return sludge with a high-rate of oxygen utilization. Approximately 50 per cent of the activated sludge is returned to the aeration tank.

Rates of Biological Activity And Growth Phases

The biological activity involved in the high-rate activated sludge process is best understood with a knowledge of a typical growth curve. Figure 2 shows a growth curve of activated sludge and trickling filter slimes. The initial conditions are that the food concentration is high and the mass of microorganisms is relatively low. Because in the activated sludge systems suspended solids are commonly used as the measure of the quantity of microorganisms, the mass of organisms is plotted versus time for the system.

During the logarithmic growth phase if sufficient nutrients as recommended by Sawyer,[2], are present the only limiting factor is the generation time of the microorganisms. This is the growth phase utilized in the high-rate activated sludge process. During this growth phase the mass of microorganisms will increase at a logarithmic rate and continue to do so until food concentration becomes a limiting factor. This is the beginning of the phase known as declining growth.

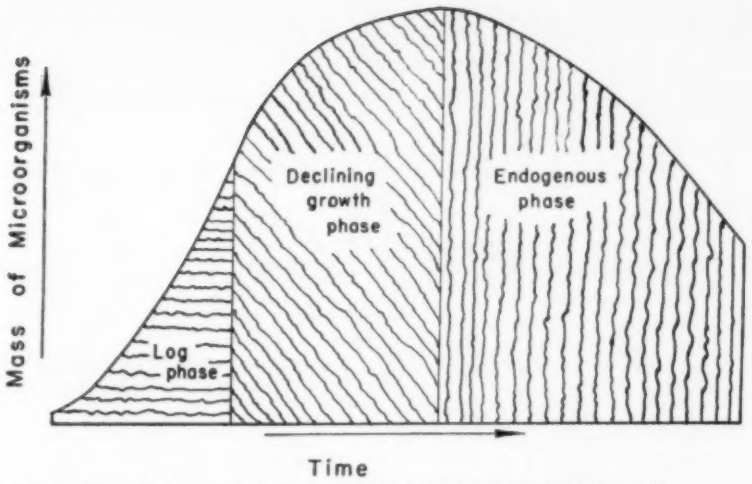


FIG. 2—Growth of activated sludge and trickling filter slimes follows this typical growth curve.

During the declining growth phase the mass of microorganisms increases at a decreasing rate, until they reach a *status-quo* condition where the rate of increase of microorganisms is equal to the rate of lysis of the cells. At this point the growth phase is referred to as endogenous. During the endogenous phase the microorganisms derive their energy from lysed cells;

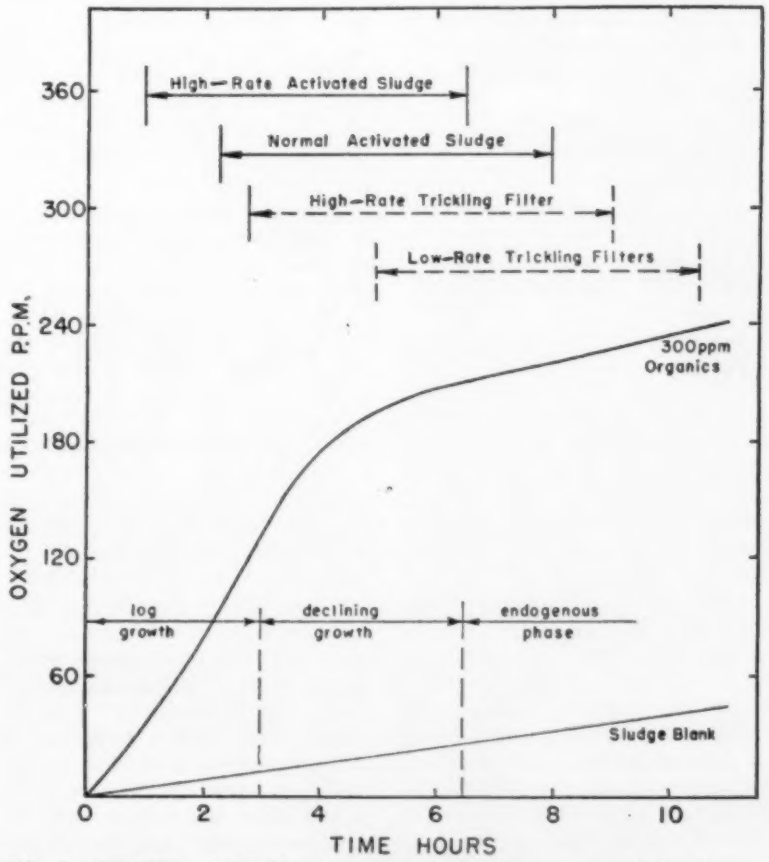


FIG. 3—OXYGEN relationships in activated sludge as measured by the Warburg respirometer.

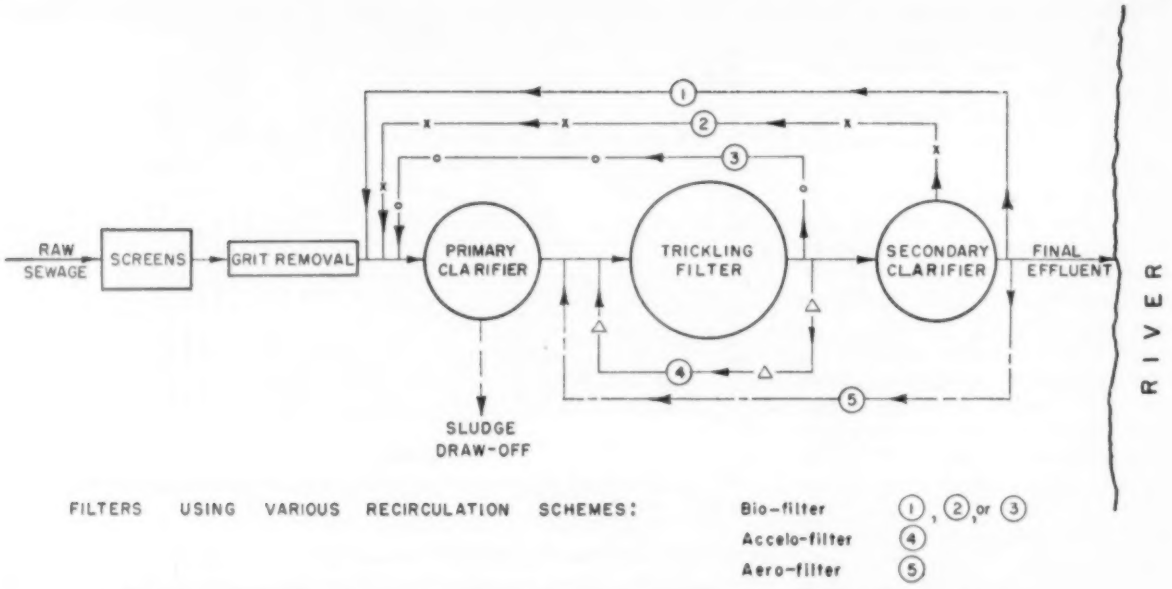


FIG. 4—HIGH RATE one stage trickling filter process operates according to this flow diagram.

therefore, the mass of microorganisms steadily decreases.

The relationship of these growth phases to the high-rate activated sludge process may be understood by studying the function of sewage treatment which may partially be expressed by:

$$\text{Organic Compounds} + \text{Microorganisms} + O_2 \rightarrow \text{More Microorganisms} + CO_2 + H_2O$$

As indicated, the organics are converted to carbon dioxide and water and more microorganisms. The only problem that remains for the sanitary engineer is to extract the microorganisms from the system. This usually is accomplished in the final clarifier.

Referring to the typical growth curve in Figure 2, it may be seen that the organics are removed from the system most rapidly during the logarithmic growth stage. However, in order to produce a highly clarified effluent the engineer must provide a means for removing the biological flocs formed during the process.

McKinney[3] has demonstrated that this is done most efficiently when the energy level of the system is lowest. Non-flocculent growths are produced during the logarithmic phase, and only partial flocculent growths during the declining growth phase, while best flocculation is accomplished during the endogenous stage. Thus, the engineer must choose the particular environment necessary to solve the problem with which he is confronted.

Rates of Oxygen Utilization And Growth Phases

The oxygen utilized by a batch-fed activated sludge system was measured with a Warburg respirometer.[4] The results (Fig. 3) show that initially the rate of oxygen uptake increases rapidly, until it reaches the point where food becomes a limiting factor. This initial period corresponds to the logarithmic growth state.

During the declining growth stage the rate of oxygen uptake continually decreases until it reaches a constant value, which corresponds to the beginning of the endogenous phase. During this endogenous phase, the rate of oxygen uptake is approximately the same as the rate of oxygen uptake of an activated sludge blank. The sludge blank system illustrated in the lower curve in Figure 3 is similar in all respects to the system illustrated in the upper curve, except that the sludge blank system did not receive the initial feed of organics.

It may be seen that the high-rate activated sludge system utilizes primarily the logarithmic growth phase, and a portion of the declining growth phase. The normal activated sludge system utilizes only a small portion of the logarithmic growth phase, operates primarily in the declining growth phase, and extends into the endogenous phase. Thus, the high-rate activated sludge system employs the advantage of a higher rate of removal of organics from the system.

Because the high-rate process does not extend into the endogenous phase, less ideal conditions for flocculation exist than in the normal activated sludge processes. This explains the lower B.O.D. removal percentages reported for the high-rate activated sludge systems. In other words, less efficient floc formation yields inefficient settling in the final clarifier, thus a higher B.O.D. in the final effluent.

Advantages and Disadvantages

Some of the advantages claimed[1] by the high-rate activated sludge systems are:

1. Savings of aeration tank volume.
2. Savings in air requirements (0.3 cu ft per gal instead of 1 cu ft per gal in normal process).
3. Flexibility of effluent quality (60 to 80% B.O.D. removal).
4. Faster recovery from shock loads (the lower the sludge age, the shorter the recovery period).
5. With weak raw sewage the primary clarifier may be eliminated.

Some of the disadvantages reported[1] are:

1. Operations must be carefully controlled.
2. Effluent quality varies during the day.
3. Final settling tank sludge must be removed as quickly as possible, because the sludge is very active.

These advantages and disadvantages appear reasonable on the basis of the information derived from Fig. 2 and 3.

High-Rate Trickling Filters

The basic principles of high-rate trickling filters may be studied by considering the flow diagram for the one-stage treatment plant shown in Fig. 4.

The main characteristics differentiating the high-rate from the low-rate trickling filter is the employment of recirculation of trickling filter effluent or settled trickling filter effluent.[5] A primary advantage of this system is that through recirculation the contact time during biological stabilization is lengthened (10 to 12 min) over that of the low-rate filter (about 1 or 2 min). Recirculation also provides a method of diluting the B.O.D. of the filter influent and aids the total B.O.D. removal. In addition, greater hydraulic penetration is accomplished; therefore, the food load carries farther into the filter.

Other advantages claimed for the high-rate trickling filter are that there are no ponding or fly problems, a constant hydraulic load is provided for the distributors, and there is an opportunity to utilize the excess oxygen present in the recirculated effluent.

Growth Phases Utilized

The relationship of the growth of microorganisms in the high-rate trickling filter to those found in low-rate filters and activated sludge is shown in Fig. 4. The high-rate trickling filter slimes utilize only a portion of the logarithmic growth phase and deal primarily with the declining and endogenous growth phases.

The ratio of food concentration to microorganisms is high in the outside layer of the high-rate trickling filter slimes and near the top of the filter. Thus, at these locations one could expect the microorganisms to experience the logarithmic growth stage.

The inner layers of the slimes and the lower portions of the filter have lower ratios of food concentration to microorganisms and experience the declining growth and endogenous stages. The higher rate of hydraulic loading causes a continuous sloughing and thinner layers of trickling filter slimes. In low-rate trickling filter slimes the thickness of the layers of microorganisms is greater and the activity falls principally into the declining growth and the endogenous growth phases.

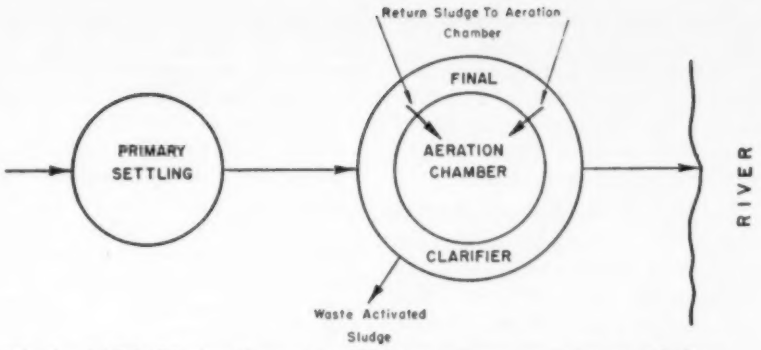


FIG. 5—PACKAGE plant for activated sludge process operates on this flow diagram.

These various growth phases in the high-rate and low-rate trickling filter slimes help to explain the different rates of biological activity in the two units. Engineers usually specify that the B.O.D. of the influent to a high-rate trickling filter be less than three times the B.O.D. of the desired settled effluent.[5] Such a limit is reasonable, and if too high a B.O.D. loading is applied to a high-rate trickling filter, the ratio of food concentration to microorganisms will be very high and the activity of these microorganisms will move to the left in Fig. 3, taking in the declining growth phase and a small portion of the logarithmic growth phase, thus yielding microorganisms that have poorer flocculating ability. This limits the degree of B.O.D. removal. In the trickling filter units, "high-rate" seems to mean a high-rate of hydraulic loading, as well as a higher rate of biological activity than in the low-rate trickling filter.

Recirculation Methods for High-Rate Trickling Filters[6]

A number of recirculation methods commonly employed in high-rate trickling filter sewage treatment plants are shown in Fig. 4. This discussion is confined to one-stage units.

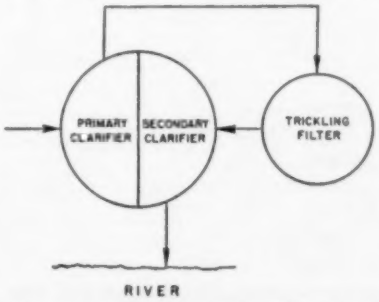


FIG. 6—PACKAGE trickling filter plant has this flow diagram.

The *Bio-filter* is usually shallow and employs recirculation of all or part of the filter discharge back to the detention tank. The filter discharge that is recirculated may be filter effluent, or secondary clarifier content, underflow, or effluent. These Bio-filter recirculation methods are shown in Fig. 4.

The *Aero-filter* process is claimed to provide a low momentary rate of sewage application whereby a high daily capacity for B.O.D. reduction is obtained. Recirculation is used principally during low flow periods. The settled filter effluent is recirculated directly to the filter distributor (Fig. 4.)

The *Accelo-filter* provides direct recirculation of unsettled effluent from the filter to the filter distributor (Fig. 4).

High-Rate Package Plants

The term "package" as applied to sewage treatment refers to the combining of two or more processes into one unit. Thus, one may find package units which combine two or more of the following unit processes:

1. Primary sedimentation.
2. Biological oxidation.
3. Biological flocculation.
4. Final clarification.

Figure 5 is a flow diagram of a package unit employing activated sludge. A flow diagram for a package unit using a trickling filter is shown in Fig. 6.

Various phases of the growth curve may apply to package-type units, as they do for each unit process separately in the conventional plants.

Bearing in mind that high-rate sewage treatment means either a high-rate of biological activity or a combination of a high-rate of biological activity and hydraulic loading, it may be possible to have these high-rate principles in a package unit.

In a unit employing activated sludge, the relative amounts of influent B.O.D. to suspended solids can be controlled so as to maintain a high ratio of food concentration to microorganisms. The resulting biological activity in the unit falls into the logarithmic growth phase. Thus, the activated sludge in the unit is principally in the logarithmic growth phase, and a high-rate of assimilation of organics is accomplished. However, the same limitation as to final effluent B.O.D. and B.O.D. removal percentages would be expected as previously discussed; that is, a B.O.D. removal of approximately 60 to 70 per cent.

With package units employing trickling filters the same requirement for high-rate operation apply as presented for high-rate trickling filters. Thus, depending on the operating conditions, high-rate or low-rate principles may be utilized in package plants.

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TRAINING PROGRAM at Cincinnati, Ohio

The Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, Education, and Welfare, is carrying on its 1958-1959 Training Program. Courses in session since June have covered radiological health and protection, water bacteriology, and air pollution sampling.

Training Objectives—The curriculum is designed to provide information on the latest techniques and nwest developments in specialized fields. Fundamentals are overlooked and the level of training is aimed at those professional engineers and scientists who are active in such fields. Only a few general courses are offered which present the overall prospective concerning specific areas of sanitary engineering.

Type of Training—All courses are short-term. Information is presented through lectures, conferences, demonstrations, laboratory and field practice, problems and panel discussions. The object is to obtain maximum trainee participation.

Admission—Admission is by application. No tuition or registration fee is charged. Applicants are notified of acceptance by personal mail. The number of trainees for each course is limited and restricted. To apply, submit standard application form and mail to:

Chief, Training Program
Robert A. Taft Sanitary Eng. Center
4676 Columbia Parkway
Cincinnati 26, Ohio

Standard Forms—Application forms are included in the back of the SEC Training Program Bulletin, may be obtained from any P.H.. Regional Office, or will be supplied from the above address.

Schedule of Courses

October 6-17, 1958
Ecology of Water Pollution

October 13-24, 1958
Analysis of Atmospheric Pollutants

October 20-31, 1958
Medical and Biological Aspects of Radiological Health

October 27-31, 1958
Inorganic Industrial Wastes Characterization

November 3-14, 1958
Plankton Identification and Control

November 17-21, 1958
Radioactive Pollutants in Water

December 1-2, 1958
Chemical Aanalyses for Water Quality

December 1-2, 1958
Sanitary Engineering Aspects of Nuclear Energy

January 12-16, 1959
Chemical Microscopy for Analysis of Air Pollutants

January 12-23, 1959
Basic Radiological Health

January 26-30, 1959
Sanitary Bacteriology of Water

January 26-30, 1959
Radioactive Pollutants in Air

February 2-6, 1959
Microbiological and Chemical Examination of Milk and Diary Products

February 9-13, 1959
Laboatory Methods for Prevention and Control of Food-Borne Disease

February 9-20, 1959
Community Air Pollution

February 16-20, 1959
Radioactive Pollutants in W r

March 2-13, 1959
Basic Radiological Health

March 2-13, 1959
Water Quality Management-Sanitary Engineering Aspects

March 16-20, 1959
Physical Analysis of Atmospheric Particulates

March 16-25, 1959
Environmental Health Aspects of Nuclear Reactor Operations

March 23-27, 1959
Analysis of Atmospheric Inorganics

May 4-5, 1959
Organic Industrial Wastes Characterization

May 4-5, 1959
Sanitary Engineering Aspects of Nuclear Energy

May 18-22, 1959
Determination of Radionucles

May 25-29, 1959
Shellfish Sanitation

May 25-29, 1959
Analysis of Atmospheric Organics

June 1-12, 1959
Advanced Training for Sanitary Engineer Reserve Officers: Water Quality Management-Sanitary Engineering Aspects

June 15-26, 1959
Advanced Training for Sanitary Engineering Reserve Officers: Community Air Pollution

Expansion challenges the engineer and the public in the development of . . .

Metropolitan Sewage Facilities

by RALPH E. FUHRMAN, Executive Secretary-Editor, Federation Sewage & Industrial Wastes Assn., Washington, D. C.

EDITOR'S NOTE: The challenge of providing safe, satisfactory and economical sewer service to the metropolitan areas will require the best in area planning, legislation, regulation and operation. The Civil and Sanitary Engineer has responsibilities in all these activities through state and regional planning activities, through the state department of health and through his services in connection with the design, construction and operation of sewage works.

This article presented as a paper at the Civil Engineering Conference on Metropolitan Planning, University of Florida reviews present problems and considers those yet to come. The trend in ex-urban growth is the primary problem area confronting safe sewage disposal in the United States.

■ STANDARD METROPOLITAN AREAS number 168 according to the 1950 U. S. Census. Such an area is defined briefly as an area containing at least 50,000 persons with a population density greater than 150 persons per square mile. Boundaries are always county lines. These areas cover 7 per cent of the area of the United States but have 57 per cent (85,000,000) of the population. In size, they range from Laredo, Texas (56,000) to New York City (12,900,000).

In the five years between 1950 and 1955, 97 per cent of the nation's growth took place in these areas, and this tendency continues. The 1950 Census showed 16,120 units of government and 2,898 special districts in the 168 Standard Metropolitan Areas. When totaled, these give each area an average 113 governmental units or districts. Is it any wonder that complex situations arise when a common aim is sought?

The growth of these areas is now proceeding at a rapid rate. The modern metropolitan area continues to grow in spite of city and sometimes state boundaries. Socially and economically, the communities are one, but politically they may be quite heterogeneous.

To the Civil Engineer viewing the area from the standpoint of drainage areas, the problems of providing sewer service seem relatively simple at first. This is so from the physical standpoint, but from legal and financial obstacles he soon encounters, the situation may become complex and uncomfortable.

In recent months it has been reported that American families have reached a total of 50,000,000. Also in recent months the figure has been given that there are 13,000,000 septic tanks in the United States. On the assumption that the septic tanks are individual household units, 26 per cent of the households in the United States are being served by these tanks.

Metropolitan Growth Effects Sanitary Engineering Problems

The Civil and engineering problems created by this fringe growth are manifold. The sanitary engineer is trying to provide the suburbanite with freedom from sewage disposal difficulties.

The person leaving a urban area for an underdeveloped suburban area gives waste water disposal virtually no thought. As long as the house drains are working properly he may not even inquire about drainage. The colors used in interior decoration may be a stronger selling point than a connection with a community sewer system. But even in the pleasant life of the suburbs, the problems of sewage disposal may soon become the main topic of neighborhood conversation. A primary problem of the engineer is to give sound advice on what plan of sewage disposal will give lasting and economical satisfaction to the area. In the city and densely populated fringes, sewers would probably be easy to finance. In the outer fringes, the problem becomes one of choice of individual household disposal or community sewers, with cost an important factor.

"Approximately 26 per cent of U.S. homes are served by septic tanks."

"Many homeowners overlook sludge removal in septic tanks and absorption fields clog.

Septic Tanks

Recent years have found the septic tank for individual household use, a subject of several studies. In areas with a high ground water table or impervious soil its use is out of the question. A properly designed and maintained tank can still serve isolated dwellings as long as the soil will assimilate the tank effluent. Unfortunately septic tanks are generally built to good standards but the householder has no interest in sludge removal. Sludge removal can easily put off one year, then two, and so on until the absorption field is clogged. Replacement of this field is a costly and unpalatable job.

Usually at this point the homeowner becomes a most ardent supporter of a community sewer system. He may also reach this position by not exercising care in water use. If he has his own well, he is naturally sparing with water use and the absorption field works nicely. With a community water supply he uses water more freely. Absorption fields may be overloaded causing effluent to come to the surface — a nuisance and health hazard. This would point to a requirement for community sewers where community water is served.

It is impossible to state accurately the population density that could have public sewers at approximately the same cost of septic tanks. The metropolitan area density figure of 150 persons per square mile seems well below such a limit.

Cost Analysis

If a single household septic tank and disposal field costs $200, and lasts 20 years, the cost is $10 per year plus a similar figure for sludge removal, or about $20 per year. The cost of septic tanks has been reported as varying from $150 to $500.[1] Some estimate a life as short as ten years. A service sewer for a 100 ft frontage at $5 per ft can be constructed so that it will last for at least 50 years, or $10 per year. Sewer service charges of $10 per year would equalize the cost for other services, including treatment. With lots 200 feet deep, streets 60 feet wide, blocks 400 feet long and 4 persons per house, the population density would be about 4,000 per square mile. These costs seem to be equivalent, but often there is a vast difference in satisfaction to the resident.

In suburban Kansas City[2] a general demand for public sewers was voiced when the population density of 1.5 per acre or approximately 1,000 persons per square mile was reached. A population density of 2,000 per square mile or more would find community sewers the most economical as well as the most satisfactory, even if the area is well suited for subsurface disposal of septic tank effluent.

To realize the full benefit of a septic tank for an indefinite period, sludge levels should be checked annually and the sludge removed when reaching a predetermined level. For full reliability this cannot be left to the owner, and the most workable plan would be one requiring the owner to contract for this service with a continuing contractor. Of course there would be an annual inspection fee and the charges for actual sludge removal, but this would certainly be cheaper than short life of a drain field or the cost and annoyance of neighborhood nuisance.

Metropolitan Authorities

During the period of genuine advance of sanitary science in the United States, there have been many metropolitan authorities established to cope with sewage problems. The matter of special districts has been the subject of a recent book by a professor of political science.[3] This book is not entirely comforting to the sanitary engineer. The author states that special districts are justified for schools, but other activities should be returned to local governments. A sanitary engineer would conclude that special district governments are justified for sewage disposal as well as schools. In spite of this, the book is an illuminating treatise on the subject and anyone contemplating the formation of a metropolitan authority could probably learn many things from it.

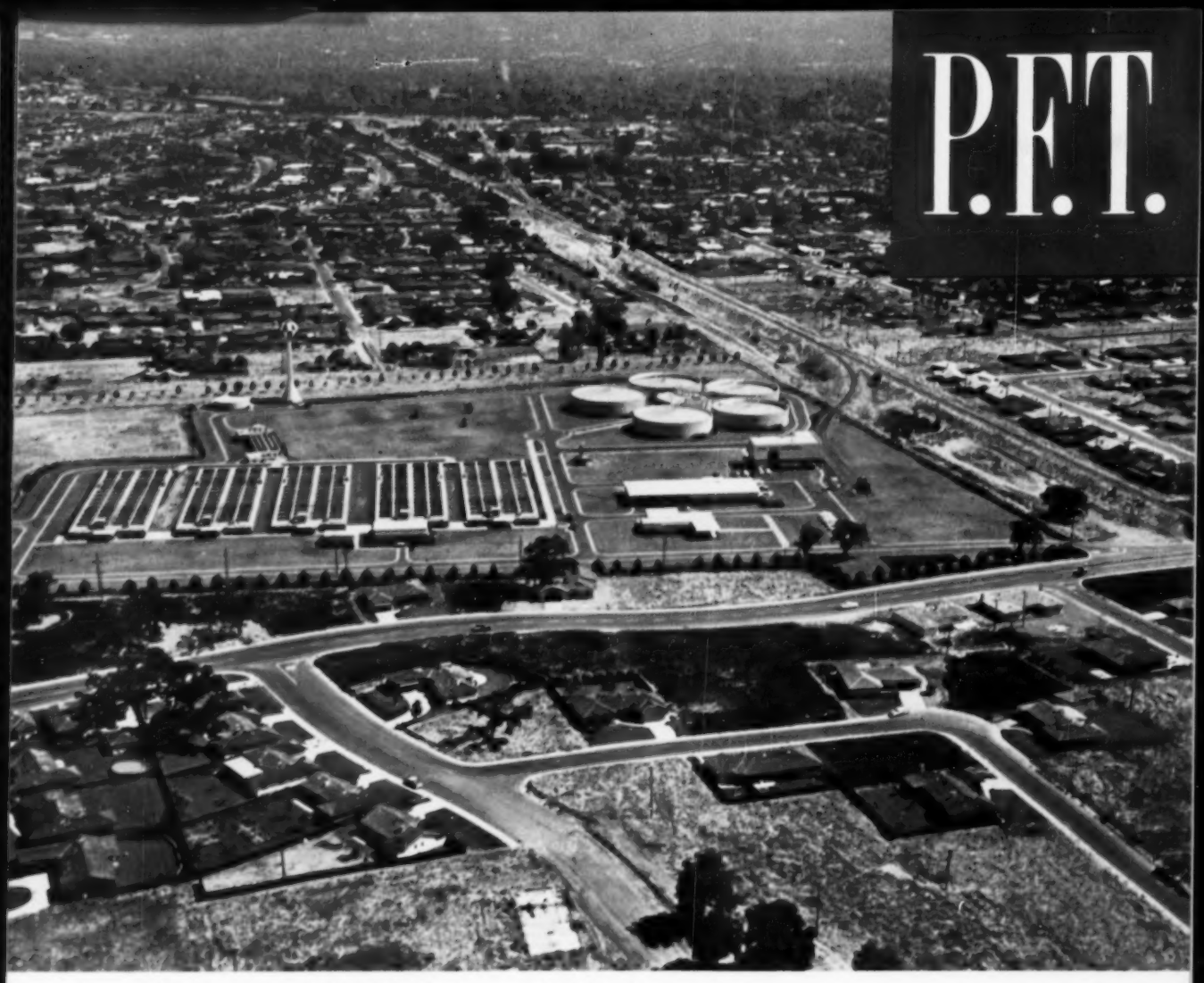
Since 1950, six additional metropolitan areas have come into existence, and many more are in the making, and others growing ever larger. Not a single metropolitan area in the United States has one government operating throughout its area. The total number of separate local governments concerned with one or more angles of public service is 1,071 in the New York area and 960 in the Chicago area. In the 14 metropolitan areas containing 1,000,000 people or more, the average is 400 local governments for each metropolitan area. The multiplicity of governments existing in these metropolitan areas results in a complexity of service and control problems.

"The number of local governments within each metropolitan area averages 400."

Other Metropolitan Growth Devices

While we may accept metropolitan districts as a proper approach, it is well to dwell momentarily on the other means which are available for accomplishing similar ends. Annexation is the first that usually receives consideration when fringe growth occurs. This is natural and normal in the community completely isolated from other metropolitan areas and state lines. The city grows in area, population and sometimes finds new problems. The 8 basic services — drainage, fire protection, garbage collection, police protection, sewerage, streets, water supply, and zoning — were *all* inadequate in areas annexed to more than one fourth of the cities reporting annexations. In addition the annexation procedure is generally laborious and complex, and results are often erratic and unpredictable.

Alternatives to annexation include consolidation such as city-county, var-



Sacramento's modern sewage treatment plant is now surrounded by fine homes.

Good Neighbors in Sacramento

Exclusive new residential development selects modern sewage treatment plant as good neighbor

Sacramento proves a point! Gone are the days when the sewage treatment plant was the unsightly skeleton in every city's closet—to be hidden "out on the old river road." In fact, in Sacramento, California, this modern sewage treatment plant has been *selected* as a good neighbor by an exclusive new residential development. As you can see, these expensive homes are being built adjacent to the beautiful treatment plant.

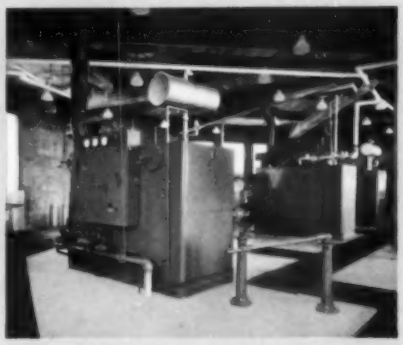
Modern sewage treatment equipment makes this all possible. Odor problems have been eliminated.

Attractive architecture and landscaping make this plant a well accepted part of the new residential area of this thriving city of Sacramento.

Sacramento is one of the many progressive cities across the country that has found that modern sewage treatment equipment—P.F.T. Equipment—and a modern sewage treatment plant are truly a civic asset. For further information on the Sacramento Story please turn this page.

P.F.T. *contributes to the Sacramento Story*

Only the most modern sewage treatment methods and equipment enables Sacramento to prove that a sewage treatment plant can now be an integral part of *any* growing community. P.F.T. equipment plays a vital part in this progressive sewage treatment program. This P.F.T. equipment includes five 100′ Floating Covers, five Cover Position Gauge Boards with Low Level Alarms, three #1000 Gas Fired Heaters and Heat Exchangers, Gas Safety Equipment.



Three PFT #1000 Heaters and Heat Exchangers make Sacramento's digestion system efficient and dependable.

Here are Sacramento's five digesters equipped with five 100′ P.F.T. Floating Covers.

Design of plant by:
Engineering Office of Clyde C. Kennedy, San Francisco.

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

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"451 Sanitary Districts exist within the United States to provide sewage disposal facilities."

iations of this combination, and city-county separation which is in effect in several locations. These consolidation moves have not met with general acceptance. This device has been used very rarely in recent years.

Other proposals to integrate city and county governments are sometimes known as metropolitan federations. Again, this has been proposed for several metropolitan areas in the United States but has not yet been put into operation. However, a number of city-county responsibilities have been shared by agreements between the two with some success.

Sanitary Districts

The first sanitary district was organized in Massachusetts as the Metropolitan District Commission giving sewage disposal service for the Boston Metropolitan Area. The second was the Chicago Sanitary District in 1889. Its name was changed to the Metropolitan Sanitary District of Greater Chicago in 1955. Now sanitary districts providing sewage disposal service are nationwide and the approximate number in existence is 451.

The State of Illinois was one of the first to see the value of municipal sanitary districts and its law authorizing their creation is dated 1917. The Chicago District was authorized as a special act of the Illinois Legislature. A complete study of these districts would in itself be an education in both political science and sanitary engineering. It is not our place here to analyze these, but to point out the role of the engineer in the formation and operation of these important organizations. Features and factors beyond the technical concern of the engineer include (1) representation of the area served and the mechanism for a democratic choice of such representatives, (2) a review of the authorities' activities by those served or their representatives from time to time to maintain the proper relation between the authority and those it serves, and (3) control of expenditures beyond those directly involved in or based on engineering considerations.

In a well detailed and informative paper on this subject[4] a general description of the sanitary district application is given. According to administrative functions these organizations are classed as (1) those which function as an arm of the state, (2) those which function as an arm of a municipal corporation, and (3) those which are created as new independent overlapping municipal corporations. The Boston and Chicago Commissions are characteristics of the first type, the Milwaukee Sewerage Commission is an organization of the second type, while most other sanitary districts fall in the third class. In general these incorporate the central city and the adjoining municipalities or unincorporated areas beyond the city limits.

A special class of organization is necessary where state lines are involved. The region of Kansas City, Missouri and Kansas City, Kansas is considering a bi-state sewer authority which will require approval of the legislatures of both states as well as the U. S. Congress. This is in line with general sanitary district developments, since the Kansas City's are essentially one city socially and economically and are in the same drainage area for sewage disposal. Another interstate example is the combined effort of Bristol, Virginia and Bristol, Tennessee. A contract between these cities has for its aim economy and effectivess in sewage disposal.

In the operation of sanitary districts the actual functions vary according to the local needs. In some instances, the sanitary district is the complete sewer system from the house connection to the point of discharge to a watercourse. This is truly the sewer authority. Many others leave in-town sewer problems to the city itself and provide interceptor, treatment and disposal service to member communities. The Joint Meeting sewer plan which originated and is used very successfully in New Jersey.

A uniform advantage of the sewer authority, sanitary district or sanitation commission is the placing of these essential sanitation services on a real utility basis. The most frequent method of financing these organizations is through sewer service charges. The use of sewer service charges both inside and outside of sanitary authorities has proved their value in meeting the needs of the public. It is interesting to note that the Illinois law denies the power of service charges, and provides for income from property tax. Many of the more recently authorized organizations are financed on sewer service charges and some originally financed on a property tax basis have been authorized to base charges on service.

Role of Engineer

It would first appear that the engineer's principal interest in metropolitan problems would lie in the design and extension of systems to serve a growing metropolitan area. Actually, there is much that an engineer should do before this time and certainly one of the great challenges is his early interest and activity in (1) citing the needs for state legislation or changes in it which would enable metropolitan areas to provide essential sanitary services based on long range decisions rather than those of expediency at times of great urgency; (2) helping in the actual drafting of legislation or changes therein which will pave the way for future progress; and, (3) watching developments and pointing out deviations from proved practice. It is certainly a fruitful field for the engineer to make a contribution as an informed citizen. Since the Second World War, engineers have been admonished for their reluctance to take part in public affairs. While he may

"Sanitary Engineers must become active in public affairs."

not have time to work as an individual, he can work with others as a committee member in organizations interested in the furthering of public health protection and economic municipal service.

A further challenge comes to the engineer when he has the task of organizing a group of communities for the mutual protection and economy of sewer service. The public relations aspect of such work can not be overlooked. The engineer can help inform the public and share factual data by reducing it to its most understandable terms.

The phase of preliminary estimates is likewise one of great importance. Costs estimates should be made with the greatest care so that upsetting increases will not have to be authorized as the project takes form. In a period of inflation, cost estimates should be labelled as to date so that they can be re-evaluated if necessary. The engineer must make decisions solely for the benefit of the area and must provide facilities for a sufficient period in the future to avoid the embarrassment and expense of early obsolescence. He must prepare plans and specifications that will fulfill future needs and be accomplished at a reasonable cost.

Upon completion of the works, it would appear that engineering work is much reduced, but it simply changes form. The operation of the project requires full skills in sanitary techniques. The operational responsibility and the administration and management of the authority are largely an engineering activity. Laboratory results on the plants and receiving waters must be evaluated to determine the accomplishments of the project. This information is necessary to justify additional improvements or system extensions. This information should be publicized sufficiently to show the authority's accomplishments and their costs.

"Real estate developers are more interested in providing public water supplies than they are in providing community sewer service."

Certainly a tremendous challenge to engineers engaged in metropolitan planning work is (1) the long range planning of metropolitan areas and (2) the enforcement of planning laws and regulations to make them of full effect and value. In addition to planning and zoning engineering, health departments are usually required to certify as to the satisfaction of water and sewer facilities. Such regulation is all for the benefit of sound metropolitan growth and development. Real estate developers are generally more eager to pipe public water supplies to their homes under construction than to provide community sewer service. This is a natural reaction, because all but the larger builders are attracted to unit by unit operation from the standpoint of financing and sales.

Aerobic Treatment Devices

Sewer services in fringe areas can become unreasonable due to the cost of sewer extensions. This has caused many developers to turn to individual household sewage treatment rather than providing a community sewer system. Although the septic tank has been in traditional use, this unit now finds itself in competition with more complicated devices which I choose to call aerobic individual household sewage treatment plants. These are being offered by reputable firms.

The development of individual household units may find application in areas where subsurface effluent disposal is out of the question or where the effluent may be discharged to a storm sewer. It is not considered entirely safe to permit the discharge of these plant effluents on the surface of the ground or small watercourses accessible to persons. The availability of a storm sewer is unlikely in an area that has not yet provided itself with sanitary sewers, but effluent discharge into a storm sewer system is a definite possibility.

Perhaps the greatest value of the aerobic plant development is in the construction of package plants for community use. With these, a small community may comply with its sewage treatment requirements and at the same time avoid the limitations of neighborhood nuisance, which septic tank effluent disposal may cause. A community benefits by having the street sewers laid early in the project development, thus avoiding costly conversion from septic tank to street sewer service. Construction of a common sewer in a street that has been paved costs three times what it would have originally.

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1. Sanitary Sewage Disposal for Subdivisions, P. W. Richards, Proceedings, SED of ASCE, August, 1957.
2. Planning Sewerage Service for Suburban Areas, R. E. Lawrence, Proceedings, SED of ASCE, February, 1956.
3. Special District Governments in the United States, J. C. Bollens, University of California Press, 1957.
4. Organizing and Financing Sewage Treatment Projects, S. A. Greeley, Transactions, ASCE, 1944.

Cleveland Approves Plastic Pipe for Water Service Lines

The city of Cleveland has approved plastic pipe for street-to-house water service lines, and has amended its building code accordingly.

According to the Pipe Division of Republic Steel Corporation, which disclosed the city's action, the Board of Building Standards and Building Appeals of the city accepted technical test data on plastic pipe's strength, and case studies on a number of private residential, farm, development, and suburban installations for water supply use. Republic's own Pipe Division was the petitioner; the steel company manufactures plastic pipe as well as plastic-coated steel pipe.

The Cleveland Board had taken notice not only of pressure capacity and heat resistance, but also considered the handling characteristics of the product.

Information upon which the board based their decision showed: Plastic pipe costs only half as much as the copper tubing conventionally used; it lends itself to speedier installation (75 per cent less time may be involved in laying and connecting a service line than would be called for with metal tubing); ease-of-installation characteristics such as the readiness with which joints may be made, by "wiping on" a solution which connects pipe to fitting in a permanent chemical bond; and the pipe may be sawed with an ordinary hand saw.

In the field of corrosion, there is no electrolysis; plastic pipe is inert.

Progress in the abatement of domestic sewage pollution is evidenced in the statistical summary of

Sewage Works *in the United States*

by JOHN R. THOMAN and K. H. JENKINS, Water Supply and Water Pollution Control Program, Division of Sanitary Engineering Services, U.S. PHS, Washington, D. C.

EDITOR'S NOTE: This is a brief tabular abstract of a U.S. PHS report by the authors. Mr. Thoman, Senior Sanitary Engineer and Mr. Jenkins, Analytical Statistician have compiled this third summary on the subject. Publ. No. 609 may be obtained by writing the Water Supply and Water Pollution Control Program, Department of Health, Education, & Welfare, Washington 25, D. C.

■ THIS SUMMARY is based on data contained in the U. S. PHS 1957 Inventory of Municipal and Industrial Waste Facilities, although the 1953 data are the latest available from Alabama, Louisiana and Michigan. It contains only data on municipal wastes and does not include industrial wastes.

The basic tabular data in the complete report are presented in three major classifications: Population groups (eight from under-500 to more-than-100,000 population), States, and drainage basins (fifteen). The data show considerable progress in combatting stream pollution by municipalities, but in spite of these gains there has been a small increase in total pollution load on streams.

Statistical Summary of Sewage Works in the United States

Data on Communities and Facilities

	1940	1945	1949	1957
Sewered Communities				
Number	8,516	8,917	.....	11,131
Population—millions	75.7	82.0	.....	102
Connected	70.5	74.7	78.9	98.4
% Connected	93.1	91.1	.....	96.4
Sewered Communities without treatment				
Number	3,597	3,610	3,718	3,165
Population—millions	29.9	27.9	28.1	21.9
Severed Communities with treatment				
Number	5,085	5,480	6,816	8,066
Population—millions	40.6	46.9	50.8	76.4
% of total sewered pop.	57.6	62.1	64.4	77.7
Type of Treatment Facilities—No. of plants				
Minor	49	60	54	41
Primary	2,889	2,829	3,019	2,730
Intermediate	2,630	98	107	100
Secondary		2,799	3,050	4,647
Total	5,580	5,786	6,230	7,518
Population served by type of treatment facility—millions				
Minor	3.3	4.3	3.9	1.8
Primary	15.1	17.2	17.2	25.7
Intermediate	22.2	3.8	3.6	5.6
Secondary		21.7	26.1	43.3
Total	40.6	47.0	50.8	76.4
Population served by type of treatment facility—millions				
Activated sludge	10.5	11.6	.....	25.0
Chemical treatment	4.0	5.3	.....	7.3
Intermittent sand filters	0.9	1.0	.....	0.9
Lagoons	.....	0.2	.....	2.4
Land application	0.9	1.3	.....	2.0
Trickling filter — std.	8.4	8.8	.....	11.3
Trickling filter— high rate		0.7	.....	6.5

Breakdown of Plant Facilities—1957

	No. of Plants	Est. Pop. Served	% of Est. Pop. Served
Primary treatment			
Septic tanks	780	1.0	3.8
Imhoff tanks	1,084	3.3	13.0
Mech. cleaned tanks	656	18.6	72.7
Plain hopper bottoms	80	1.3	5.2
Others	130	1.3	5.3
Total	2,730	25.5	100.
Secondary treatment			
Activated Sludge			
Mech. Aeration	259	0.9	2.1
Diffused air	284	20.2	46.5
Other	46	3.7	8.5
Trickling filters			
Standard rate	1,870	9.3	21.6
High rate	812	6.0	13.8
Sand filters	394	0.8	1.9
Land application	340	1.0	2.3
Oxidation ponds	430	0.8	1.8
Other	212	0.7	1.5
Total secondary treatment	4,647	434	100.
Chlorination	2,216	37.8	.....
Grit removal	1,581	51.7	.....
Sludge processing			
Septic tanks	1,120	.....	.....
Inhoff tanks	2,759	.....	.....
Stage digestion	272	.....	.....
Separate digestion	2,790	.....	.....
Drying beds	5,342	.....	.....
Lagoons	167	.....	.....
Mech. dewatering	197	.....	.....
Miscellaneous	2,007	.....	.....

The 31st Annual Conference of Penna. State University presented many discussions on . . .

Water Works Operations

EDITOR'S NOTE: The arrangement of presentations followed by periods for questioning and the scheduling of extra sessions for open discussion afforded every opportunity for the members to submit individual problems and exchange ideas. Particular presentations covered the subjects of coagulation, taste and odor, financing, safety, impounding reservoirs, and equipment.

The two hour clinic on water works operation was called "The Linn Enslow Water Works Operation Clinic" in honor of our late editor of *Water and Sewage Works*. Linn always took an active part in these discussion periods. The staff of this magazine on behalf of his family and ourselves, thank the membership of the PWWOA for this thoughtful gesture.

R. P. Ferringer
President

■ THE NEWLY established president of the PWWOA for the forthcoming year is "Rube" P. Ferringer, Commissioner of the Brookville Borough Water Dept. The First Vice President is Vernon B. Corle, Manager, New Castle Water Co. and the Second Vice President is George W. Williams, Sr., Manager, Homesdale Water Co.

George W. Williams Sr. was also awarded the I. M. Glace award for being the outstanding man in the Water Works Industry in the state of Pennsylvania.

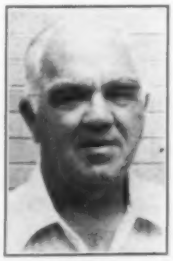
Here are some excerpts and abstracts from the talks given:

■ DREDGING AND GUNITING OF IMPOUNDING RESERVOIRS by R. P. Ferringer, Commissioner of Brookville Borough Water Dept.

The Borough of Brookville is served by water impounded reservoir. No villages or industries are located within 97 miles on the upstream side of the dam, however, logging operations and run off from the mountains watershed caused a build up of silt, logs, stumps, and other debris in the basin of the reservoir.

The 46 year old dam, designed for a life expectancy of 50 years, required repairs and renovations to provide the desired storage capacity and protect the quality of impounded waters.

Prior to draining the reservoir a by-pass cast iron pipe was laid around the reservoir to intercept the upper waters in order to provide water service to the municipality. No difficulties were experienced during the reconstruction to cause an interruption in water service.



L. S. Duckworth
Past President

V. B. Corle
1st Vice President

Dredging of the reservoir basin was accomplished by contract at a cost of 78 ¢/cu yd. The contractor used a pan in the areas of the basin where the equipment could be supported. The need for trucking dredgings was held to a minimum. The drag-line and other heavy equipment was supported by log mats which were moved ahead of the equipment, as it moved.

The basin was made narrower since dredgings were used for embankments and scooped to an average of 6 ft depth throughout. The basin was backfilled with a minimum of 6 inches of sand. Concrete retaining walls, aprons, and spillways were re-surfaced using gunite.

The entire cost of restoration was nearly $40,000; $8,000 of which included the re-usable cast iron by-pass pipe. The storage capacity was increased 8 mg and shallow areas supporting undesirable vegetation were eliminated.

■ TASTE AND ODOR CONTROL EXPERIENCES IN PENNA. IN COMPARISON WITH THE ENTIRE U. S. by E. A. Sigworth, Water Purification Division, W. Va. Pulp & Paper Co.

The U. S. representatives to the International congress required information concerning taste and odor experience in Water Works practice. Of the questionnaires sent throughout the United States, 241 were completed and returned. Of these, 31 were from Penna.

To differentiate between tastes and odors, physiologists report that man can perceive only the four tastes; salty, sweet, sour, and bitter; and all the rest are odors. Odors are in a wide range of musty, cucumber, fishy, medicinal, etc.

Algae was listed as the cause of taste and odors on 82 per cent of the 241 questionnaires. Decaying vegetation was recorded on 67 per cent, trade wastes on 28 per cent, and miscellaneous in 23 per cent. These figures do not imply that only one agent is the sole source of taste and odors. They represent both one and a combination of causative agents.

Activated carbon was the chief single item in use throughout the U. S. for control of taste and odor. The use

IVAD M. GLACE, Cons. Eng. of Glace & Glace, Harrisburg, Pa., died, September 7, from a suspected heart attack.

of activated carbon in conjunction with chlorine, applied 10-15 minutes before chlorination, was reported in 33 per cent of the reports. The practice of adding the two at the same time was reported in 40 per cent of the cases.

Taste and odor conditions caused by trade wastes are the most difficult to correct. Penna. has the majority of such problems, but has been able

H. A. Dewire
Secretary

E. A. Sigworth
Taste & Odors

to maintain better threshold odor valves than elsewhere in the U. S. She also reports better success with the use of chlorination, super chlorination, and chlorine dioxide control for tastes and odors than the overall U. S.

The city of Chicago reports that taste and odor control treatment costs in excess of the entire purification process. Hammond, Ind. adds activated carbon in a range from 10-125 mg/L for taste and odor removal.

■ FINANCING OF IMPROVEMENTS OF SMALL WATER WORKS by V. F. Rigling, General Manager, General Water Works Corp.

Municipal ownership, of course, differs from private owned water works in financing improvements. Municipal ownership has the advantage of other funds not necessarily derived from water works revenues, although, even here financing becomes a problem.

The demand for water and water service is increasing. The problem is made difficult by new housing developments, and industry being located on the outskirts of the municipalities, sometimes in elevated areas or out of the way areas and service to which may require complete renovation of the existing distribution system.

The common method of financing water main extensions or improvements is by investment of earnings and deficit financing. The extension of a distribution system claims the biggest capital outlay. Here, a requirement for a rate increase is inevitable either before initiating construction or at some later date. The cost, therefore, falls on the present consumers which is hardly an equitable situation.

The fair and sound approach for such financing is through refundable deposit agreements. In such agreements, the consumer must deposit the amount of the cost for installing his individual service and have this amount returned to him. This refund can be calculated in various forms, but for example, say he is returned 3½ times his first years water service charge within a specified period of time (5 to 10 yrs.) which continues until the deposit is returned.

Refundable deposit agreements should be propounded to suit each individual situation. If an industry has the men and equipment to satisfactorily complete any phase of the proposed construction in providing a water service, he should be allowed to do this. The industry in turn should not be charged for improvements which are purely municipal.

The refundable deposit agreement is a sound business approach for small water works facilities, and even large operations with insufficient assets to finance expansion. This is the fair method of not burdening existing consumers with the cost of service for new consumers.

■ NEW AND NOVEL EQUIPMENT by Marsden C. Smith, Director, Water Bureau, Dept. of Public Utilities, Richmond, Va.

The increased use of cement lined cast iron, cement asbestos, or other corrosion resistant pipe causes a terrific rate of corrosion on unprotected valves. A lining for valves is being experimented with.

A standard meter vault can be installed around a meter upon installation of that meter. The component parts of the vault may be ordered separately and assembeld to desired size around the meter. Such vaults will withstand considerable loads, but are not suggested for installation in the street.

An oil filled water meter with a non-breakable plastic face mounted flush on the top is available. The oil serves to lubricate the dial mechanisms and prevents condensate from forming on the inside of the meter face. Dirt collecting on the face can be easily removed from the flat surface. The hands which the meter-reader must read are painted red. If the hands move clockwise, a large red dash is placed in the center of the face. If the dials move counter clockwise, the face will be left plain. This allows the meter-reader to read the meter by noting the position of the hands even though he can not see the numbers.

V. F. Rigling
Financing

M. C. Smith
Equipment

Power savings through installation of variable speed pumps at zone pumping stations will return the addition cost over constant speed pumps within four years. Fully automatic pumping stations are better maintained than manually operated pumps.

During installation of new mains, sterilizing can be accomplished more effectively and easier if hypochlorite pellets are placed in each section of the pipe, using permatex or other adhesive to glue the pellets to the upper inside surface of the pipe. In this manner the hypochlorite will be available only after the pipe is full.

■ "UTILITIES PUBLIC SAFETY" by George W. Truman, Senior Staff Asst., Bell Telephone Co. of Penna.

Accidents don't happen, they are caused; everyone loses from an accident, and no one gains. In the United States last year 38,000 persons were killed in automobiles, 28,000 in the home, and only 14,000 at work in industry. For every man hour lost in industry 20 are lost from injuries in the home. Why can't man practice safety at home and away from the job?

Safety requires team work. At one time, it applied to tools and guides as its basis, but today it requires a study of men. To administrate safety, you must understand yourself, your boss and the people you supervise. Safety is a human business.

The Editor's Comments

Hail to FSIWA

This is the month when the Federation of Sewage & Industrial Wastes Associations meets in Detroit for its 31st annual meeting. It will be a record meeting for number of technical sessions, number of papers presented and, it is hoped, for attendance.

In honor of the Federation, approximately 80 per cent of the pages in this issue are applicable to sewage treatment, including the two lead articles about the host city to the Federation meeting, Detroit, Mich. This disproportionate amount of sewage material in this issue practically equalizes the extra amount of pages devoted to water works in the April issue.

Terminology and Semantics

Since this is Federation meeting month, it is a good time to comment on sanitary engineering terminology. Elsewhere in this issue is an article on "high rate sewage treatment." With the manuscript, the authors supplied a number of article titles clipped from various magazines; from these it is obvious why our technical language leads to confusion.

From their study, Professors Ryckman and Edgerly conclude that there are two meanings for the term "high rate" with reference to sewage treatment. While this dissertation clarifies these meanings, it does not simplify the confusion, nor does it consider the term "high rate" as used in water treatment.

We in this field of endeavor need some research and development in terminology and semantics. The trouble is we can't even agree on whether or not we are engaged in sanitary engineering, public health engineering, or environmental health engineering. Although the American Academy of Sanitary Engineers has been established to upgrade the profession and to certify as to the professional standing of its members, it has not decided whether or not to categorize its Diplomates according to several specialties. — I wonder what the master plumbers who have been members of the National Society of Sanitary Engineers for 30 years think of the relatively recent Academy of Sanitary Engineers.

It is not just a professional title on which we are hazy —for example, we need a good word for the treated effluent of a sewage treatment plant, and we certainly need a better word for "sewage." We could use such a word to improve our public relations. The Germans have a perfectly logical word, "abwasser" (from water) and the British use the simpler "trade wastes" for industrial wastes. We have borrowed a good many useful words from both the Germans and of course from the British. If we can't come up with a better word for "sewage" why not adopt the word "abwasser"? Then we could have a Federation of Abwasser and Trade Waste Associations.

Speaking of semantics — when the Publications and Program Committee of the Federation scheduled a "symposium" of five papers on synthetic detergents research, the American Association of Soap and Glycerine Manufacturers objected to the use of the word "symposium" because of "the unfavorable connotation of the word."

It has been my experience, over many years of program committee work in various organizations, to find that the word "symposium" is used to denote a session devoted to a series of papers on a single theme; a "forum" is a session devoted to an open discussion of listed or unlisted topics, sometimes related, sometimes not; a "round table" is similar to a "forum" but usually follows a scheduled breakfast, although not necessarily so, and it is less formal than a forum; a "panel" is a group of "experts" who present discussions or answer questions from the audience or the leader, on different phases of one general topic (it differs from a symposium in format and often in formality of presentation).

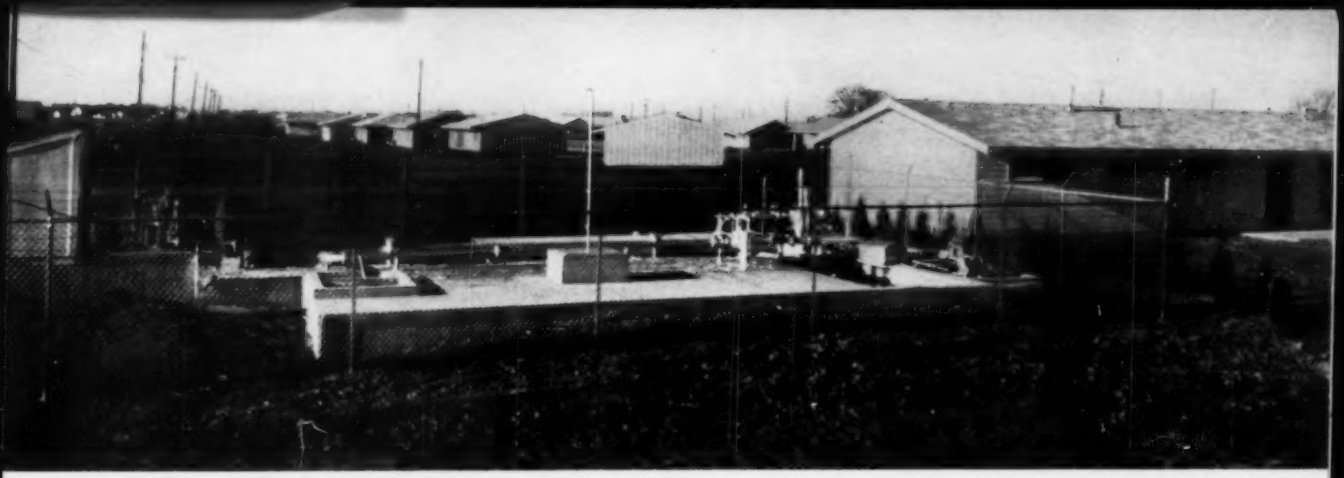
If we are going to have individuals or trade associations object to words used in our field because of "unfavorable connotation," then we are in dire need of some standardization of terminology, something our present glossary of engineering terms does not really provide; it deals only with strictly technical words and phrases and even there, it is open to criticism.

The Federation is to be congratulated for a start in the right direction with its adoption and publication of a set of standard units of expression for wastes and waste treatment (FSIWA MOP No. 6) — Incidentally, beginning in January 1959, this magazine will use those units in all articles where applicable.

This cry for standardization and clarification of terminology is no recent idea with me. In November 1942, I wrote a guest editorial for *Civil Engineering*, titled "What's Wrong with Sanitary Engineering," in which among other things I called for the use of "Sanitary Engineering" to describe our field of endeavor. I haven't changed my mind much since then. Right now, I want to suggest to the Federation that it appoint a Committee on Semantics and Terminology to straighten out this mess we are in and particularly to develop a new word for "sewage." — If they do, this magazine will change its name accordingly.

Maybe a joint committee of AWWA, ASCE, APHA and FSIWA should attack the problem, but the youthful Federation's forward step in developing standard units of expression makes it a logical leader in the movement.

George E. Symons.



SUBDIVISIONS
Gorman View Subdivision, Perrysburg, Ohio
Design Flow—30,000 G.P.D.
Approx. Plant Area—40 x 60 Feet

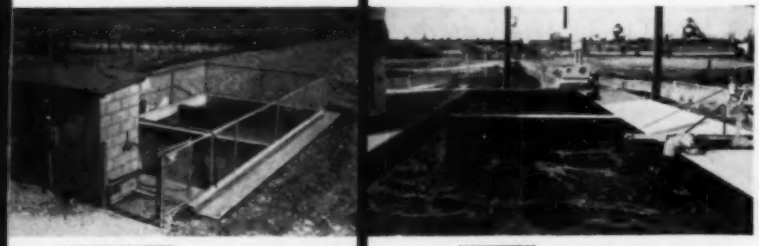
"from Chicago" RATED AERATION*

*a trademark of Chicago Pump Company

Small Unit Sewage Treatment Process Equipment for 20 to 5,000 People

SCHOOLS
Kennedy School, Louisville, Kentucky
Design Flow—7,500 G.P.D.
Approx. Plant Area—20 x 30 Feet

SHOPPING CENTERS
Westgate Shopping Center, Lima, Ohio
Design Flow—15,000 G.P.D.
Approx. Plant Area—30 x 30 Feet



MUNICIPALITIES
Valley Springs, California
Design Flow—40,000 G.P.D.
Approx. Plant Area—30 x 45 Feet

INDUSTRY
B. F. Goodrich Co., Oaks, Pennsylvania
Design Flow—56,000 G.P.D.
Approx. Plant Area—35 x 55 Feet

CONVENTS
Ancilla Domini-Villa Maria—Donaldson, Indiana • Design Flow—40,000 G.P.D.
Approx. Plant Area—30 x 45 Feet

HOSPITALS
Tuberculosis Hospital, Lima, Ohio
Design Flow—20,000 G.P.D.
Approx. Plant Area—26 x 28 Feet

Features

- Odor free
- Nuisance free
- Lowest cost sewage treatment
  - Low original cost
  - Low cost sewer lines . . . plant located within subdivision
  - Low operating and maintenance costs
  - Economically expendable . . . for area planning of future sewage systems
  - Small, compact plant area
  - Centralization means more homes per acre
- Expandable—by multiple units
- Exclusively successful standardized balanced equipment
- Applicable in steel or concrete units

For

Subdivisions	Dairies
Schools	Motels
Industry	Hotels
Military Installations	Trailer Courts
Hospitals	Airports
Municipalities	Camps
Convents	Country Clubs
Shopping Centers	Resorts

Equipment Application Information Available To Your Engineer From Chicago Pump Company Distributors Located In Most Principal Cities.

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Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

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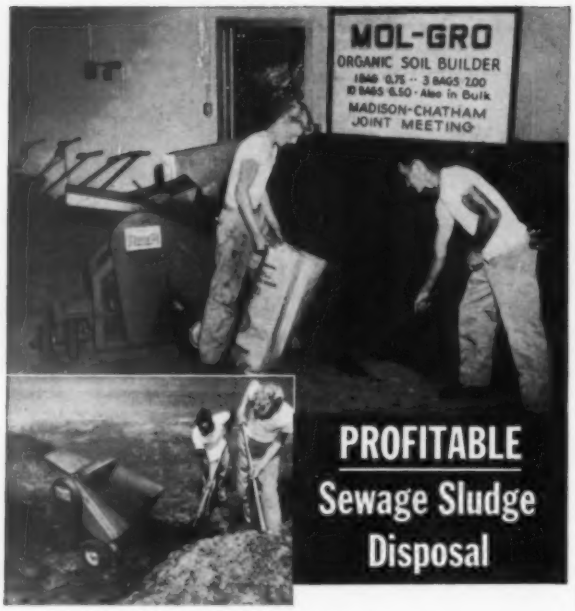
622 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS



PROFITABLE
Sewage Sludge Disposal

The Madison-Chatham (N.J.) Joint Meeting bags and sells their *Royerated sewage sludge cake*. While not big business, the operation does represent an additional source of municipal income.

The need for increasing municipal income keeps growing in importance. The climate of today's economy warns against tax increases. Economies of operation are being searched for.

One of the most obvious economies that any organization can practice is the elimination of waste. Yet many sewage plants continue to dump or burn their sludge cake—throwing away or sending possible income up in smoke.

In April 1957, Royer published a new edition of their "Sewage Sludge Utilization Datalog," pointing the way to turning sewage from an expense into a profit. Since then, we've gone through two printings.

If your community is still destroying this source of revenue, write today—and learn how you, too, may experience *profitable sewage sludge disposal.*

described in FREE DATALOG

Please send me a copy of your new edition of the information-packed "Sewage Sludge Utilization Datalog."

Name _____ Title _____

Plant _____

City _____ Zone _____ State _____

☐ I am interested in a demonstration of the Royer Shredder at work.

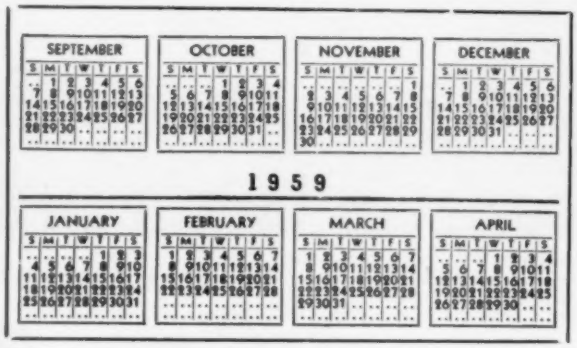
ROYER FOUNDRY & MACHINE CO.

ROYER

170 PRINGLE STREET
KINGSTON, PENNA.

Meetings

1958



Oct. 5-9—Detroit, Mich. *(Sheraton-Cadillac Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N.W., Washington 16, D. C.

Oct. 9—Bingham, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Oct. 13-17—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, W. H. Wisely, Exec. Secy., 33 W. 39th St., New York 18, N. Y.

Oct. 14-17—Atlantic City, N. J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSN., Secy., David Dunlap, 2609 N. Second Street, Harrisburg, Pa.

Oct. 15-17—Des Moines, Ia. *(Hotel Fort Des Moines)*
IOWA SECTION, A.W.W.A., Secy., J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Ia.

Oct. 19-22—Quebec City, Prov. Quebec *(Chateau Frontenac)*
CANADIAN INSTITUTE ON SEWAGE & SANITATION, Dr. A. E. Berry, Administrative Office, 72 Grenville St., Toronto 8, Can.

Oct. 19-22—No. Miami Beach, Fla. *(Golden Gate Hotel)*
FLORIDA SECTION, A.W.W.A., Secy., John G. Simmons, Supt., Water Dept., Box 1311, West Palm Beach, Fla.

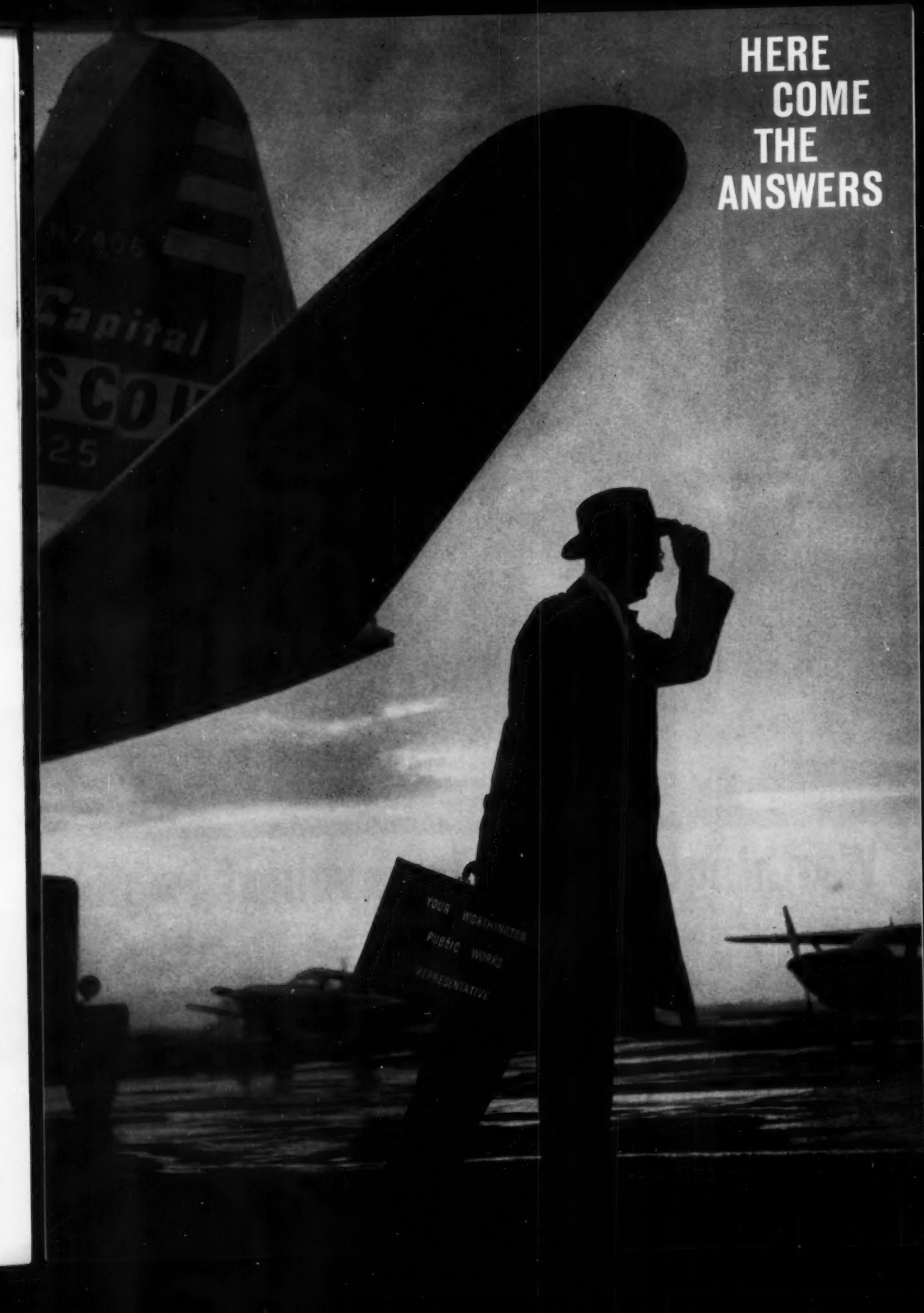
(Jointly With)
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Ralph H. Baker, Jr., State Board of Health, P. O. Box 210, Jacksonville 1, Fla.

Oct. 22-23—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES Assn., Secy., Glen O. Fortney, State Dept. of Health, Charleston 5, W. Va.

Oct. 23-24—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Union Carbide Chemicals Co., Div. Union Carbide Corp., P. O. Box 8361, So. Charleston 3, W. Va.

Oct. 23-25—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION, A.W.W.A., Fall Meeting Secy., Albert F. Pleibel, 683 Prospect St., Maplewood, N. J.

Oct. 27-29—Pittsburgh, Pa. *(Penn Sheraton Hotel)*
19th ANNUAL WATER CONFERENCE, Secy., W. M. Porter, Engineers' Society of Western Pennsylvania, Penn Sheraton Hotel, Pittsburgh 30, Pa.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COME
THE
ANSWERS
Capital
YOUR WORTHINGTON
PUBLIC WORKS
REPRESENTATIVE

Worthington's vast reservoir of Public

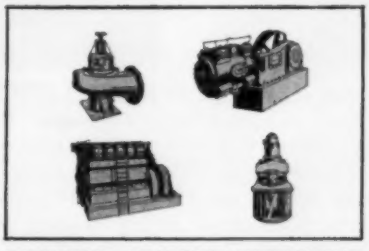
In Public Works there is no adequate substitute for experience. Worthington's experience in this essential field dates back to 1854 when the company's founder installed his first municipal water works pumps at Savannah, Georgia. Others soon followed. A duplex pump was installed at Charlestown, Massachusetts in 1863. Pumping engines were installed in Fort Worth, Texas in 1893. Twelve triple-expansion engines were put in at Philadelphia, Pennsylvania in 1908. Now the list is almost endless. There is hardly a municipality in the United States today that does not have a Worthington pump, compressor, engine or comminutor in service. This vast, cumulative experience and know-how proves invaluable year-in, year-out to communities in search of the very finest in service and equipment.

Key personnel in Worthington's Public Works Department have a combined experience in all phases of water and sewage plants of over 100 years.

Works experience is at your service

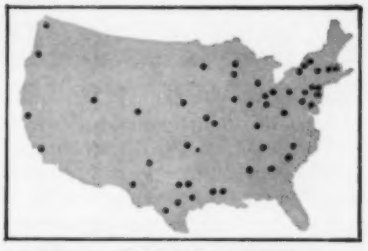
NATION-WIDE EXPERIENCE

Public Works representatives from Worthington criss-crossed the nation during 1957 bringing their knowledge to hundreds of municipalities. In so doing, they increased their skills by solving scores of local problems on equipment selection and application.



EXTENSIVE PRODUCT EXPERIENCE

Worthington makes a complete line of specialized equipment for water and sewage works. These are Worthington's basic products and the year they were introduced. Pumps (1840), Compressors (1893), Engines (1896), and Comminutors (1948).



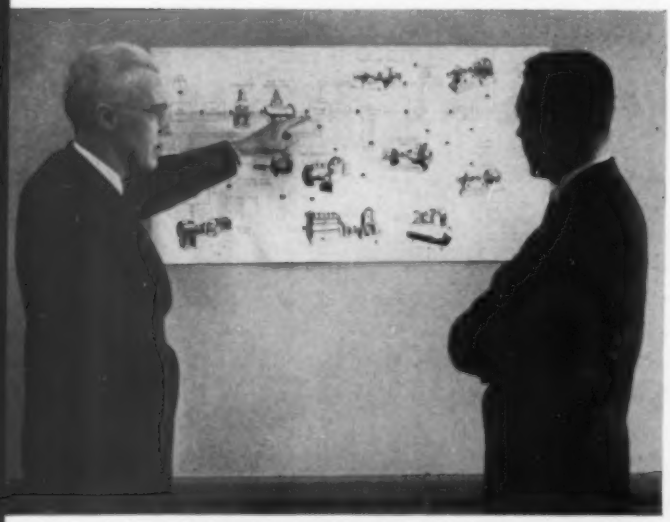
REGIONAL REPRESENTATION

A network of Worthington Offices spans the nation, from New England to California, from Canada to Mexico. Staffed with experts trained in every phase of Public Works, these offices are your assurance of the best possible equipment and the finest possible application.

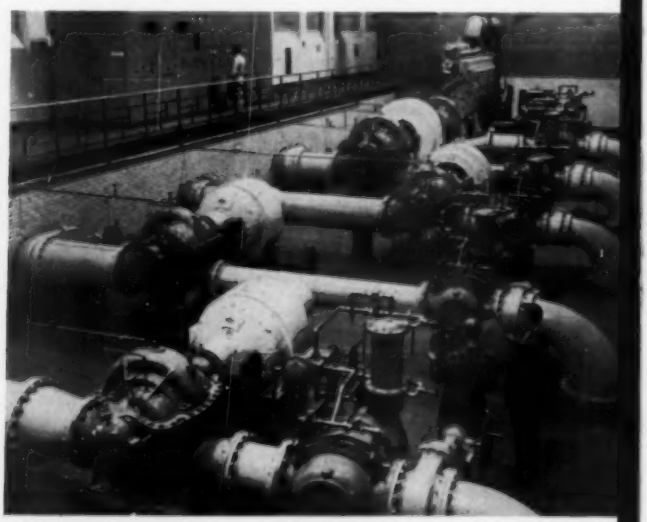
THE 4 BASIC SERVICES
of Worthington's Public Works Department

PLANNING Worthington experts will assist your consulting engineers in planning water and sewage plants. This coordinated planning care is why so many Worthington users report such long, outstandingly trouble-free operations.

EQUIPMENT COORDINATION Every municipality is different. No two systems are alike. That's why equipment must be versatile and coordinated. Because Worthington makes so wide a range of equipment, the most complex problems are quickly solved without compromising effectiveness of the system in any way.



EQUIPMENT SELECTION Because Worthington designs and manufactures a complete line of equipment, a Public Works Representative can make a substantial contribution to the operation of every plant. Using Worthington equipment limits your supply responsibility – makes for greater plant efficiency and integration.



INSTALLATION Public Works specialists are few and far between. Worthington is fortunate in having so many on its staff. They will work with your consulting or contracting engineer in solving installation problems of equipment. It's the soundest way to build *dependability* in your systems.

WORTHINGTON

For illustrated brochure on Worthington's Public Works Department, or address of your nearest Worthington District Office, write: Worthington Corporation, Section 105-3, Harrison, New Jersey.

New Bulletins

CONTINUED FROM PAGE 41A

oped, lightweight, low cost, corrosion-resistant insert plastic Dall Flow Tube, Model DFT-PI. The bulletin includes photographs, dimensional and cost-comparison tables, cutaway views and performance charts in addition to the explanatory text.

According to the bulletin, the new Dall Flow Tube is made of fiberglas-reinforced epoxy or polyester resins with metallic thoat lining, and is available in a variety of sizes and flange and throat materials. It retains the advantages of the basic Dall design, such as very low head loss, short laying strength, and high accuracy, within 1% of actual flow rate and within ½% when calibrated.

Sewage System Data File

1019

Kenco Pump Div., The American Crucible Products Co., Cleveland, O., has just released a new data file on septic tank and sewage applications which presents a complete round-up of underground and above-ground disposal filter systems together with engineering data on Kenco's complete package alternator, the Kenco-Trol, and Kenco's new heavy-duty septic tank pumps, Models 119 and 130.

Designed as a handy reference for architects, engineers, plumbing contractors and builders, this Data File describes two open-type above-ground disposal systems, three underground systems, the Nodak system, a basement apartment sewage unit, and a typical flood-control unit. In each, the use of Kenco's new heavy-duty submersible pumps is shown increasing the efficiency of the system's operation.

Incinerator Catalog

1020

Joseph Goder, Inc., Chicago, Ill., has available a catalog designed to present complete information on all phases of incinerator selection, installation and operation for every type of refuse destruction. This new illustrated catalog is titled "The Incinerator Blue Book."

Orderly information is compactly and conveniently presented in an easy to find and easy to read manner. For example, the Incinerator Selection Chart covers residential, industrial, commercial, school, institution, hotel and miscellaneous classifications with columns giving specific types, estimated quantities of waste, type of waste, class of incinerator, comments and reference page numbers.

Waste Analysis and Waste Classification Tables amplify each point. An illustrated section covers the 3 methods (inclined front, top, and floor level) feeding or charging of refuse. Conversion and Weight Estimating Tables for containers and waste types give measures in cu ft. Specification Tables accompanying illustrations and descriptions of each type of incinerator simplify complex information into quick-reference columns. Diagrams of installations identify every construction detail and show advantages of such exclusive features as: free-sliding sectional ash grate design, step-grate, double flue construction, automatic draft control dampers, inclined door and frame, etc.

Digester Brochure

1021

Infilco, Inc., Tucson, Ariz., has just published a 12-page brochure on the anaerobic process in sewage and waste treatment. Replete with diagrams and illustrations, and printed in two colors, it discusses successful methods in the treatment of sewage sludge and other organic wastes by digestion, and describes various types of digesters with a section on suggested specifications.

Reference Chart Details Sewer Connections

1022

Keasbey & Mattison Company, Ambler, Penna., has announced that plumbers, suppliers, contractors and builders will be aided materially by a new reference wall chart available from the company.

This handy new "how-to-do-it" reference chart shows the most efficient way of connecting asbestos-cement sewer pipe with sewer pipe made from other materials. It is profusely illustrated.

Concrete For Sewerage Work

1023

Portland Cement Association, Chicago, Ill., has available a reprint from their Journal entitled "Concrete for Sewerage Work."

The article discusses fully, concrete for sewage works and the control of concrete corrosions. Characteristics, and treatment of sewage are briefly reviewed, along with the conditions of exposure of concrete in such construction. Quality of concrete, construction practices, and other steps necessary to minimize concrete corrosion are presented.

The article also discusses the control of hydrogen sulfide where it is generated.

Liquid Level Gages and Valves

1024

Jerguson Gage & Valve Co., Burlington, Mass., has just published an 8-page, easy-to-use catalog for the engineer. It illustrates standard and special function gages and valves; gives dimensional drawings, construction features, pressure-temperature graphs and ratings, materials, tables of sizes, specifications and standard and optional features. Illustrated with photographs and drawings.

Products for Sewage Disposal Plants

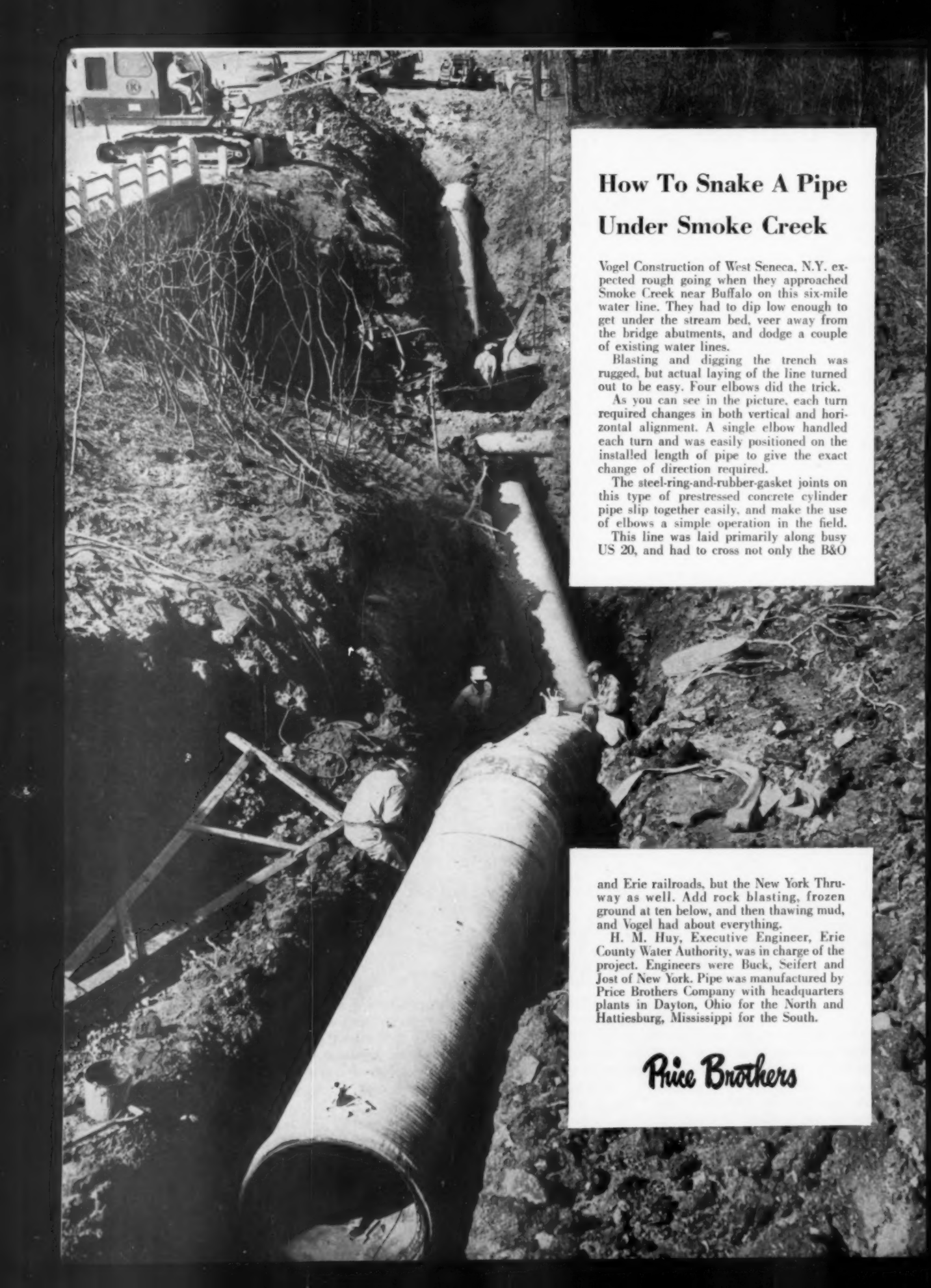
1025

Rockwell Manufacturing Co., Pittsburgh, Pa., has just issued a newly revised 24 page bulletin describing all Rockwell products for sewage disposal plants.

The new bulletin which supersedes a 20 page earlier edition has a number of entirely new features including: 1. a detailed description of the construction, installation and maintenance of Rockwell sewage gas meters; 2. a two-page line drawing of a typical piping arrangement for sewage gas meters; and 3. instructions on how to read the index on large capacity gas meters.

Other Rockwell products described in the bulletin are gas regulators, Rockwell-Nordstrom lubricated plug valves and water meters. Installation photographs, line drawings and specification tables supplement the text.

CONTINUED ON PAGE 111A



How To Snake A Pipe Under Smoke Creek

Vogel Construction of West Seneca, N.Y. expected rough going when they approached Smoke Creek near Buffalo on this six-mile water line. They had to dip low enough to get under the stream bed, veer away from the bridge abutments, and dodge a couple of existing water lines.

Blasting and digging the trench was rugged, but actual laying of the line turned out to be easy. Four elbows did the trick.

As you can see in the picture, each turn required changes in both vertical and horizontal alignment. A single elbow handled each turn and was easily positioned on the installed length of pipe to give the exact change of direction required.

The steel-ring-and-rubber-gasket joints on this type of prestressed concrete cylinder pipe slip together easily, and make the use of elbows a simple operation in the field.

This line was laid primarily along busy US 20, and had to cross not only the B&O and Erie railroads, but the New York Thruway as well. Add rock blasting, frozen ground at ten below, and then thawing mud, and Vogel had about everything.

H. M. Huy, Executive Engineer, Erie County Water Authority, was in charge of the project. Engineers were Buck, Seifert and Jost of New York. Pipe was manufactured by Price Brothers Company with headquarters plants in Dayton, Ohio for the North and Hattiesburg, Mississippi for the South.

Price Brothers

New Bulletins

CONTINUED FROM PAGE 109A

Pump Application Movie

1026

Torque-Flow Pump Div., Western Machinery Co., San Francisco, Calif., has available a movie titled "The New Twist in Pumping." This 16 mm movie describes the design and operation of the unique Wemco Torque-Flow Pump.

The twenty-three minute color movie shows the design and operating characteristics of this non-clog pump. Drawings, cut-away models, and transparent pumps are used to illustrate the radically different construction of this pump that makes it completely non-clogging and unusually resistant to the effects of abrasion.

Of particular interest are on-the-job scenes showing the Torque-Flow Pump in a variety of applications, many of an unusual nature, in the mining, paper, food processing, sanitation and waste disposal industries.

Digital Telemetering System

1027

Control Corporation, Minneapolis, Minn., has available a catalog detailing the TM-16 telemetering system.

The catalog fully describes both the electrical and mechanical counters and information storage units; the scanner-transmitter; the receiver and digital readout units.

Corrosion Controlled Wrought Iron

1028

A. M. Byers Co., Pittsburgh, Pa., has just published an 8-page booklet on "4-D Wrought Iron, A New Dimension in Corrosion Control." It discusses in detail Byers latest product development, 4-D wrought iron, which is 25% more corrosion resistant than standard wrought iron.

The four-color booklet includes a test section which is graphically illustrated, and shows the comparative corrosion resistance of 4-D wrought iron, standard wrought iron and other ferrous metals.

Three pages are devoted to actual installations, describing applications and service conditions. Service life of each metal involved is also listed.

Some of the applications mentioned are: brine lines, boiler feed water lines, condensers, gas lines, heater coils, heat exchangers, high temperature services, hot water lines, oil well piping, railings, salt water piping, sand handling equipment, smoke-stacks, steam condensate lines and tanks.

Flanged Coupling Adapters

1029

Smith-Blair, South San Francisco, Calif., has available a series of three coupling adapter bulletins showing eight ways of using these adapters with all types of pipe.

The bulletins are amply illustrated by actual installation photographs and step-by-step installation instructions. Specifications and types are also included, along with prices on some units.

Water Pollution Prevention

1030

The Portland Cement Association, Chicago, Ill., has released an attractive 2-color mailer on "Untreated Sewage a community menace."

The Association in its efforts to help in the task of water pollution control, prepared this mailer that points out the damaging effects of pollution and illustrates the benefits to be derived from the construction of sewage treatment facilities.

The mailer should be useful in campaigns for pollution control, or to point up the necessity of properly treated sewage.

Laboratory Flowrator Kit

1031

Fischer & Porter Co., Hatboro, Pa., has available a specification sheet describing the Laboratory Flowrator Kit.

According to the specification sheet, the kit consists of three all-glass variable-area flowmeters with rubber hose connectors mounted in a light-weight carrying case. The kit provides a convenient means of checking field or laboratory flows, ranging from 20.3 cc/min to 6.6 gpm for liquid and from 910 cc/min to 27.0 cfm for gas.

Rubber Pipe Fittings

1032

Luzerne Rubber Company, Trenton, N. J., has issued a bulletin describing Luzerne Hard Rubber Pipe Fittings and Valves. This 8-page, 2-color, 8½ x 11 folder gives complete detail concerning Luzerne natural hard rubber and Buna-N-synthetic rubber. In addition to much general information regarding characteristics and handling, the folder consists of diagrams and dimensions of threaded fittings, check valves, pet cocks, bibcocks and many types of valves. Physical properties of both natural and Bun-N rubber are included, as well as a long list of the chemical resistance of both types to various reagents.

Blowers-Exhausters

1033

Chicago Blower Corp., Chicago, Ill., has released a new bulletin describing the company's complete line of centrifugal, general ventilation, exhauster and axial airfoil fans, turbo pressure blowers, spin induced draft fans and roof ventilators.

The illustrated 4-page folder describes the products and their application and contains a chart showing size and capacity of each of the various fans and blowers. The fans are capable of air movements ranging from 220 cfm to 324,960 cfm, according to the bulletin.

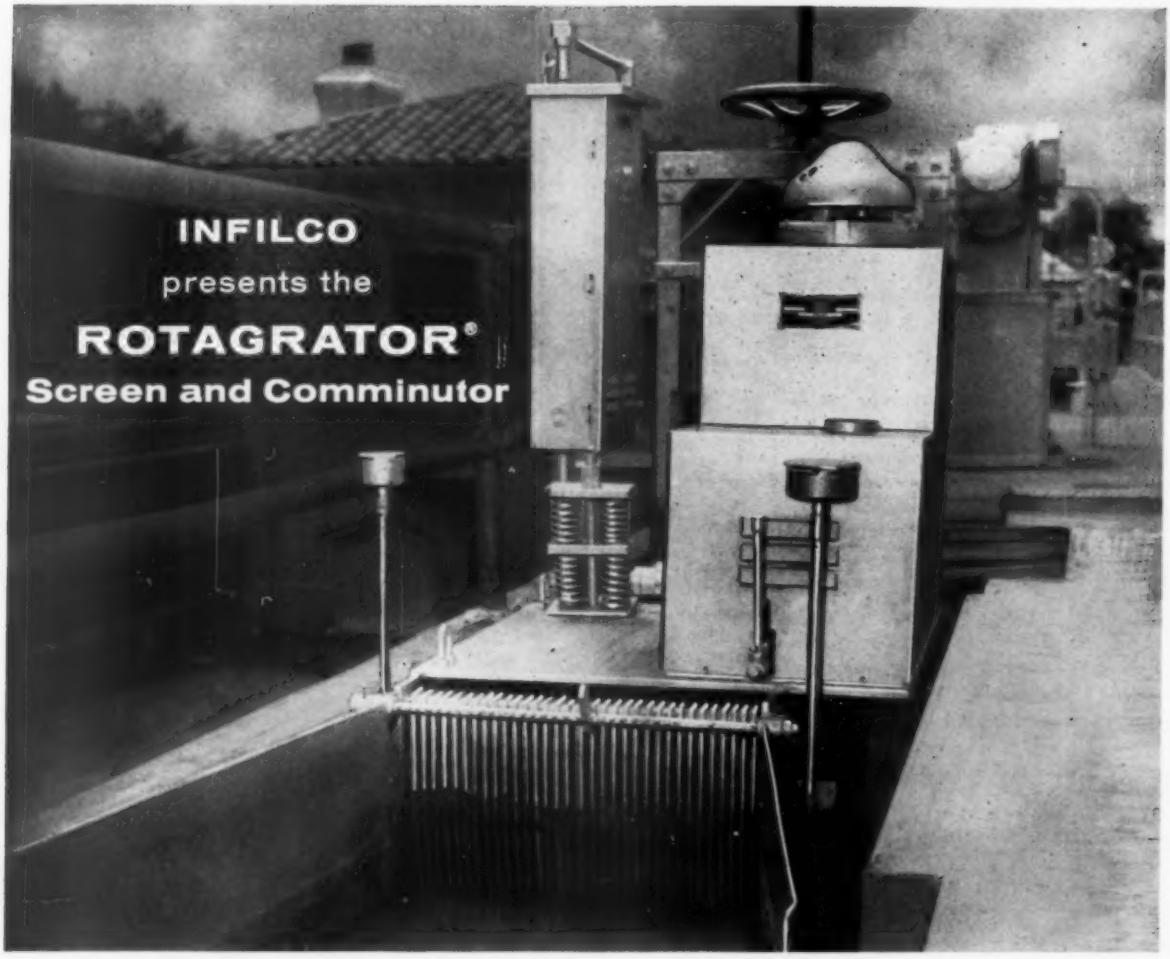
In-Place Cement Lining of Pipe

1034

Centriline Corporation, a subsidiary of Raymond International Inc., New York, N. Y., has available a new catalog describing a process of in-place centrifugal cement lining of pipes from 4 to 144 inches in diameter.

Featured in the 20-page catalog is a new machine which centrifugally lines pipe as small as four inches, and requires no excavation at laterals. The literature also covers the development and advantages of the Centriline process. It illustrates how the process increases pipe carrying capacity, stops leaks in water and sewer lines, prevents corrosion in steel and cast iron pipe, and is applied at a small fraction of the cost of new pipe.

Also included in the catalog are sample specifications, test results and case histories of unusual public and industrial projects.

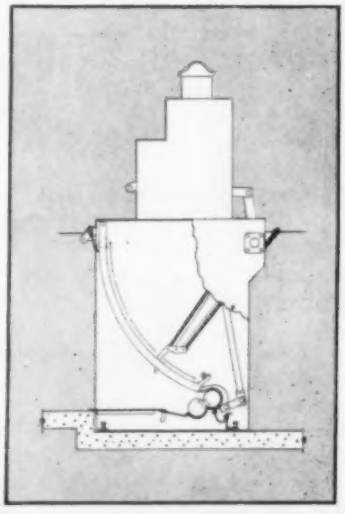


...for faster, more complete
COMMINUTION OF SEWAGE SOLIDS!

Proved in field operations, this improved screen and comminutor will out-perform and outlast any other equipment of its type on the market.

Most materials are handled in a single pass. Rollers at the bottom of a curved bar screen intercept heavy solids—lighter ones are raked down automatically. Any over-size comminuted solids are automatically rescreened and returned to the comminuting rollers until reduced to a size that permits passage through the screen.

No matter what the load may be, the unit operates continuously without harm to the mechanism, because of its rugged construction and safety devices incorporated in its design.



The "ROTAGRATOR" screen and comminutor is a completely packaged unit ready for simple and easy installation. A full range of sizes is available. For complete information write today for Bulletin 5150-A.

INFILCO

Over 60 years of engineering leadership in water, sewage and waste treating equipment.

Infilco Inc.
General Offices: Tucson, Arizona
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Field offices throughout the United States and in foreign countries.

The ONLY Company IMPARTIALLY offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 59421

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that **keeps a point** on Mylar,
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And Duralar is available (pencils, leads and lead holders) in five special new degrees of hardness (K1 to K5).

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MARS

J. S. STAEDTLER, INC. HACKENSACK, N. J.

Gentlemen: Please send me FREE

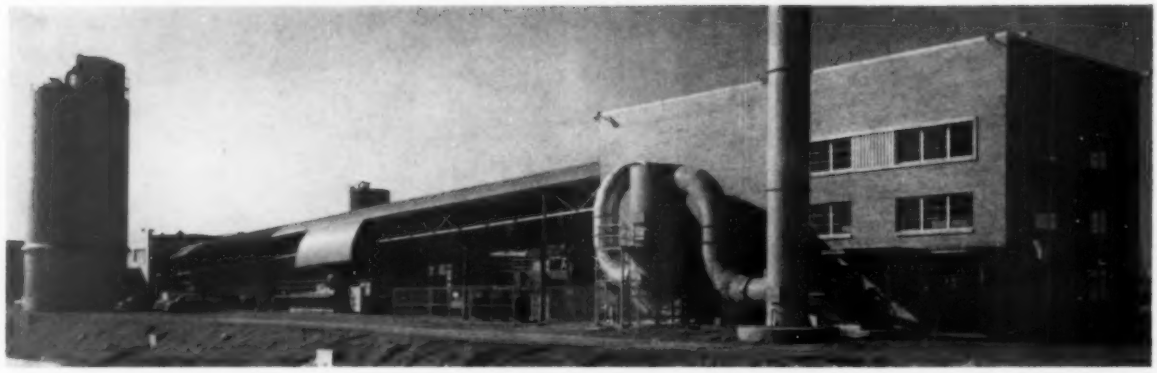
☐ The revolutionary new DURALAR pencil
☐ Include a sample of Mylar film for testing the DURALAR pencil.

NAME _____ TITLE _____

FIRM _____

STREET _____

CITY _____ ZONE _____ STATE _____



Up to 150 tons of lime a day can be recovered by Dayton's Lime Recalcining Plant. City expects to get its $1,330,000 plant investment back in 20 years — plus a surplus estimated in the millions. *Consulting Engineers: Black & Associates, Gainesville, Florida.*

at City of Dayton –

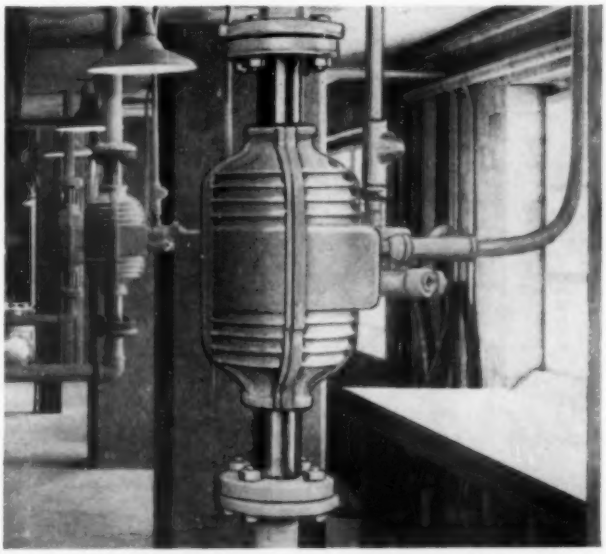
self-amortizing lime recovery plant designed around Magnetic Flow Meters

Dayton, Ohio's million dollar lime recalcining plant would warm the cockles of the thriftiest Scotsman's heart. Designed to recover lime used in softening city water, the plant actually recovers up to 20% more lime than originally added, with additional capacity to process most of the lime sludge accumulated over the last 5 years! City plans to sell the overage — recover its investment in short order.

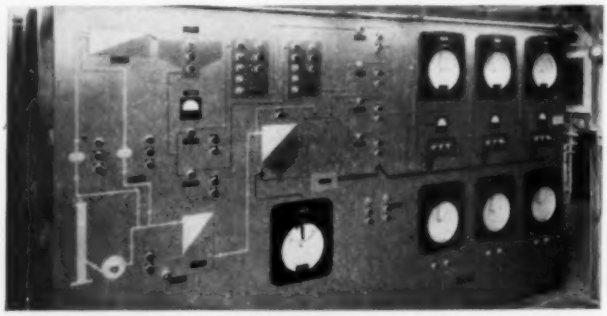
Dayton's Lime Recalcining Plant was designed around Foxboro Magnetic Flow Meters. Sludge, which would foul-up conventional head-loss devices, is easily measured since these unique meters have no flow restrictions. Measurement is instantaneous—continuous—linear. Rate of flow to centrifuges can be controlled exactly.

Maintenance on the Magnetic Flow Meter is practically nil. There are no pressure taps to get plugged or frozen . . . no seals or purges . . . no moving parts to foul.

For practically *any* liquid, however "difficult", you'll find the Foxboro Magnetic Flow Meter a sound investment. Find out about this fabulous instrument today. Ask your Foxboro Field Engineer for details, or write for Bulletin 20-14C. **The Foxboro Company, 8910 Neponset Avenue, Foxboro, Massachusetts.**



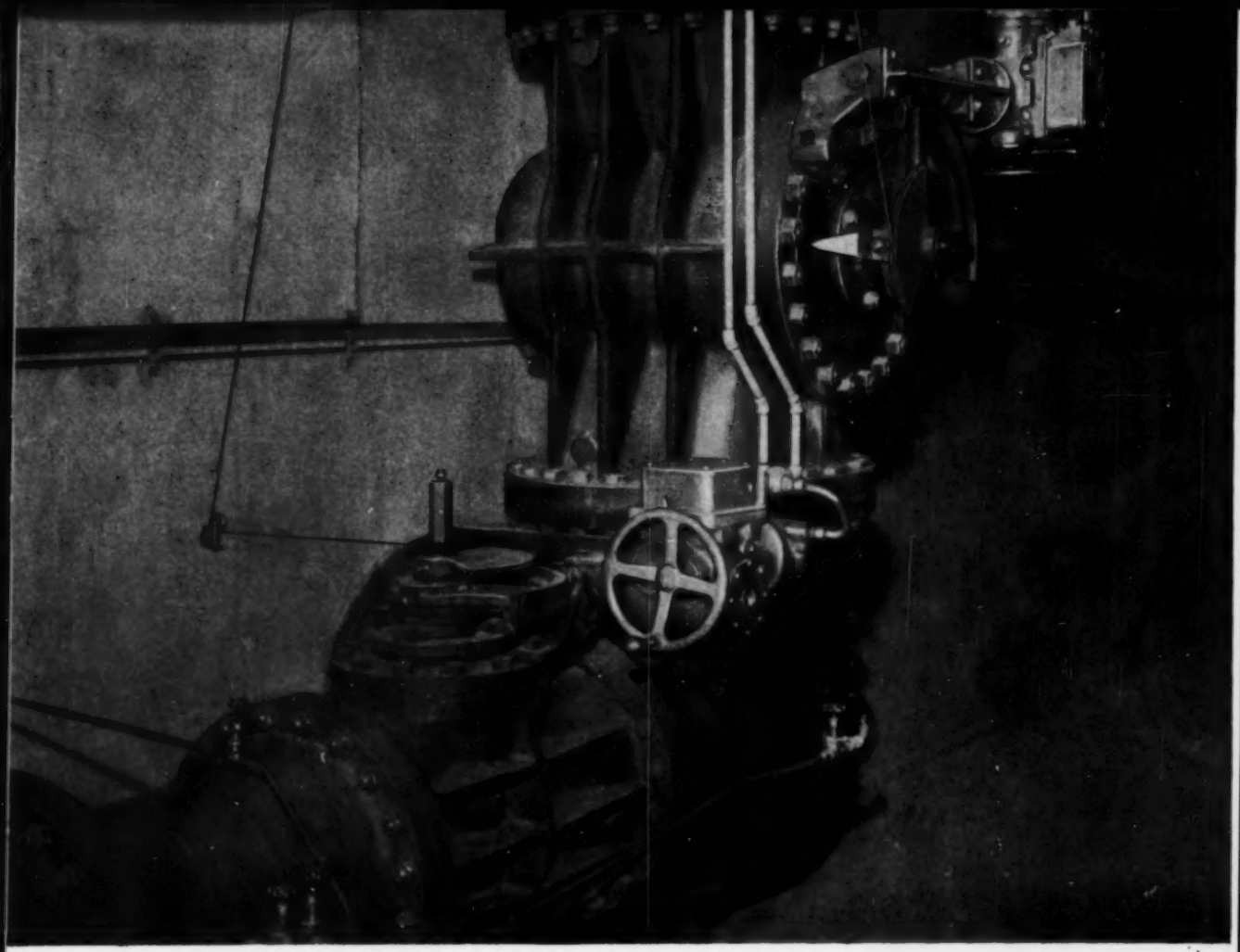
Three Foxboro Magnetic Flow Meters record and control the flow of sludge to centrifuges at Dayton's Lime Recalcining Plant. Meters cannot plug up because they have no flow restrictions.



"Graphic control panel in Feed End Building is helpful in breaking in new operators and in explaining the operation to visitors," reports Plant Supt. Robert C. Stout.

FOXBORO
REG. U.S. PAT. OFF.

MAGNETIC FLOW METERS



HOW TO SIMPLIFY AUTOMATIC FLOW CONTROL

. . . and cut costs in the bargain

ROCKWELL-NORDSTROM LUBRICATED PLUG VALVES **are easier and less costly to automate because they're lubricated and they close with only a quarter-turn of the plug.**

Ordinary valves, especially in larger sizes, are costly and complicated to equip with power actuators because the seating members have to be raised, lowered and wedged-in for a tight seal. Rockwell-Nordstrom valves are sealed with pressurized lubricant and they close with just a smooth quarter-turn of the lubricated plug. The result: simple, easy, automatic operation that's two to five times faster yet without fear of water hammer.

You'll save money with Rockwell-Nordstrom valves year after year. Lubrication eliminates metal-to-metal wearing friction for longer valve life, less down-time and lower maintenance.

Rockwell-Nordstrom is the world's most *complete* line of lubricated plug valves, plug valve lubricants and operating accessories. They cost no more to buy, often less, than ordinary valves. Send coupon for complete details. Rockwell Manufacturing Co., Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

it's **ROCKWELL**

MANUFACTURING COMPANY

Rockwell Manufacturing Co.
Pittsburgh 8, Pennsylvania

☐ Please send me Bulletin C-5200.

☐ Please have your sales engineer call.

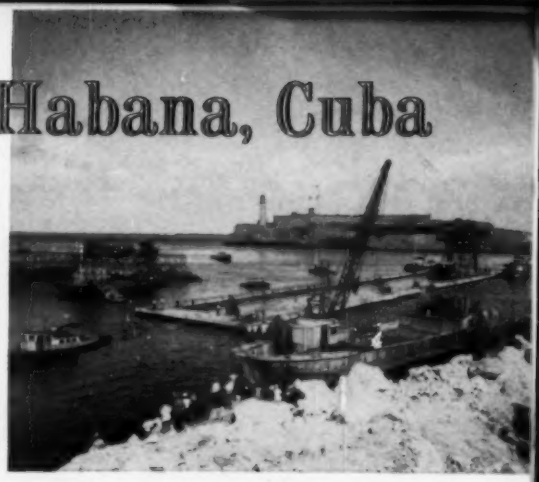
Name_____ Title_____

Address_____

City_____ Zone____ State_____

Tunel de la Habana, Habana, Cuba

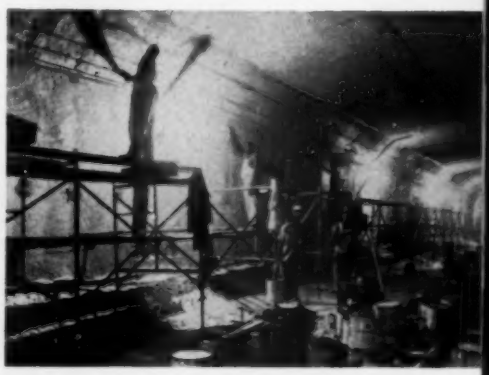
Remarkable engineering accomplishment, protected from water with the **Thoro System Products**



Four-lane, underwater tunnel, connecting Malecon Drive, City of Havana, Cuba with Guanabacoa near the famous Morro Castle, opening the sparsely-populated peninsula to residence and commercial activity.

Mammoth precast concrete sections are floated to location by attached pontoons, lowered 24 meters under water and connected to previously-sunken sections. ***Note the famous Morro Castle. Top center background.***

Design, engineering and construction by Societe des Grand Travaux de Marseilles, Paris, France, 733 Meters Long, 23 Meters Wide, 7 Meters High, cost $28,500,000.00. Waterproofed inside and outside with THORO System products, THOROSEAL, WATERPLUG and THORITE.



From Havana side, tunnel entrance grades down to harbor pool level.

Thoro System Products applied, completes the job!

Preparing interior surface for WATERPLUG and one brush and one trowel coat of THOROSEAL. All walls, floors and ceilings are sealed with THOROSEAL.

Two double-lane tunnel sections take shape; forms will be filled with poststressed concrete.

THOROSEAL is being applied to all interior surfaces. Over 800 drums of WATERPLUG have already been used, where water was entering and where sections were joined together. All honeycomb and construction faults were sealed with THORITE Patching Mortar before lowered to position in the bay.

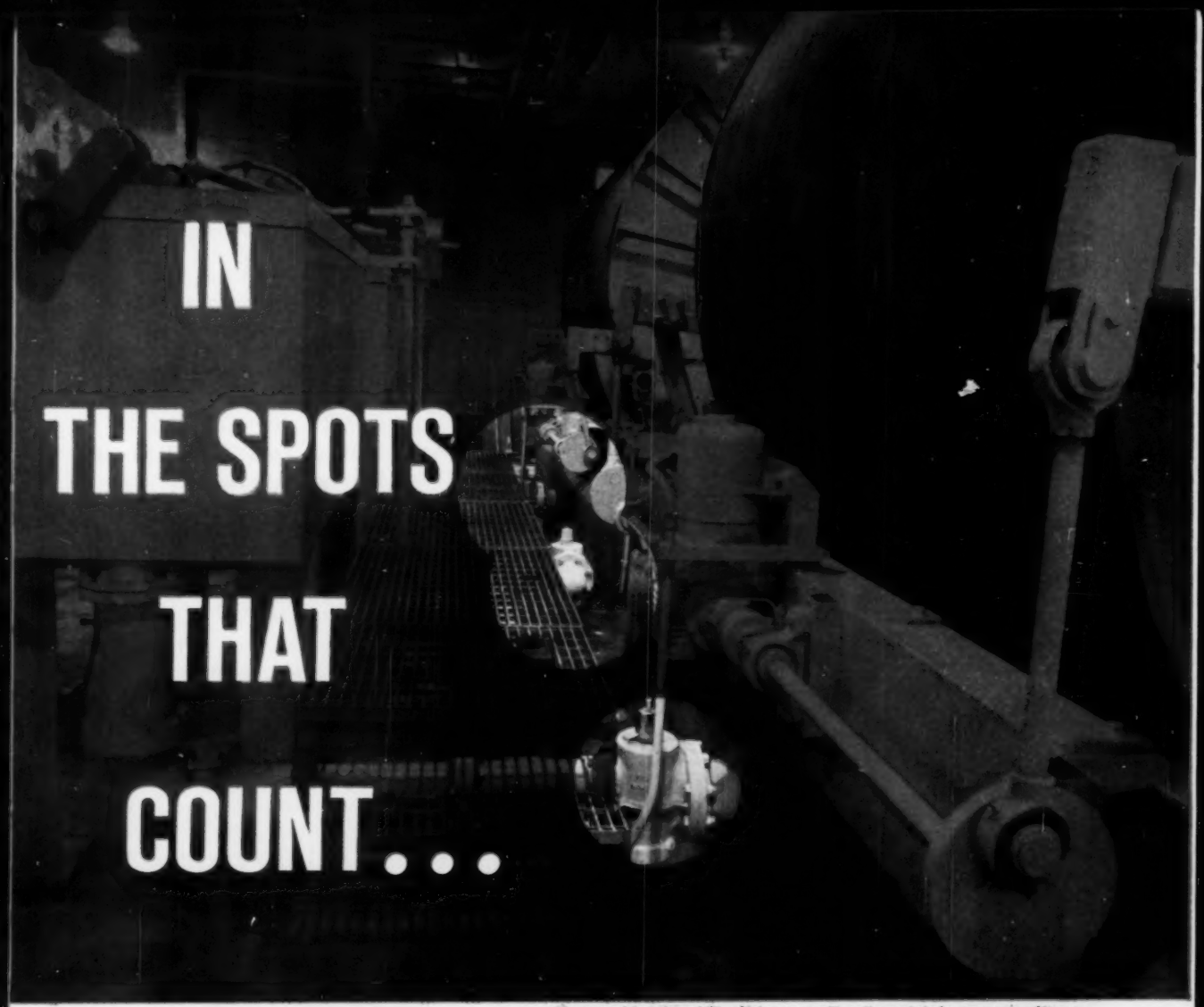
Thousands of drums of THOROSEAL, WATERPLUG and THORITE Patching Mortar are being used on this vast project.

Precast sections of tunnel, honeycomb patched with THORITE Patching Mortar and entire surface protected with THOROSEAL.

Write for literature "HOW TO DO IT"

Standard Dry Wall Products, Inc.

NEW EAGLE, PA. CENTERVILLE, IND.



Homestead Lubricated Plug Valves controlling digested sludge to vacuum filters.

Sewage plants make important savings in maintenance costs with Homestead Valves

Pump overloading resulting from restricted port area valves is eliminated by the 100% pipe area of Homestead Lubricated Plug Valves.

This, coupled with Homestead's controlled pressurized lubrication and positive chemical seal, results in years of trouble-free, low cost service. Study of your pipe lines will reveal many instances when Homestead Valves can help you achieve lower maintenance costs. Write today for complete information.

hv

HOMESTEAD VALVE MANUFACTURING COMPANY
P.O. Box 42 • Coraopolis, Pennsylvania

Please send me catalog on Homestead Lubricated Plug Valves. We are interested in this specific application:

.....

.....

Name.....

Street.....

City.....Zone.....State.....

News of Suppliers

Smith Appointed Dist. Mgr. for Robertshaw-Fulton

Robertshaw Fulton Controls Co., Philadelphia, Pa., has announced the appointment of Lewis V. Smith as district sales manager in Cleveland for the Robertshaw Thermostat Division. The Cleveland office is located at 6116 St. Clair Ave.

Mr. Smith's territory includes northern Ohio, western New York, western Pennsylvania and West Virginia.

Mr. Smith joined the Robertshaw organization in 1942 as a laboratory technician and later became laboratory supervisor. In 1951, he was transferred to Cleveland as sales engineer in charge of the company's customer service laboratory, and later to direct sales in 1953.

A. M. Byers Promotes Cumming

A. M. Byers Company, Pittsburgh, Pa., has announced the appointment of John G. Cumming as manager of the firm's southwestern division with headquarters in Houston, Texas.

Mr. Cumming has been with the Buyers Company as a field service engineer in New Jersey, working out of the firm's New York Division Office.

Mr. Cumming was graduated from Ohio Wesleyan University with a Bachelor of Arts Degree and has done graduate work at Newark College of Engineering. Prior to joining Byers, he was employed for six years by the Delaware, Lackawanna & Western Railroad Company as a traffic representative.

Hersey Presents "See It Now" Program

The Hersey Manufacturing Co., of Dedham, Mass., combines plant tours with a "See it Now" type of program for visiting water commissioners and city officials.

Well-planned in advance, the tour follows an interesting path through the administrative offices, foundry, machine shop and finally the testing section.

Here, set up on a test bed, is placed an ancient meter obtained from the visiting officials' own community. The presence of the meter is the result of close co-operation with the community's water commissioner and the Hersey representative.

Hersey test men put the old meter on a line adjacent to a brand new Hersey meter of the same size and type. By comparison testing the meter readings are listed on a blackboard and quick calculations by statisticians illustrate the approximate amount of revenue the old meter lost each year.

One water district superintendent found that his meter was off by five per cent, which meant that his community lost $1500 each year through that meter. By replacing it with a new Hersey FM meter the cost was paid off in a year and a half due to added revenue.

Kerotest Moves L. A. Office

Kerotest Manufacturing Company, Pittsburgh, Pa., Office and Warehouse moved to a new location—3151 East 12th St., Los Angeles 23, Calif.

Boyd N. Gee is the Sales Representative who will utilize the new office as headquarters. Phone number is: Angelus 8-3609.

The move establishes Kerotest in a more centralized location than that previously held, and all correspondence should be directed to the new address.

Commercial Filters Acquires Industrial Filtration

Commercial Filters Corp., Melrose, Mass., a subsidiary of Ogden Corp., has acquired the Industrial Filtration Company, manufacturers of Delpark Filters.

Robert L. Fielding, president of Commercial Filters, announced that Delpark will operate as a part of Indiana Commercial Filters Corp. with headquarters in Lebanon, Indiana. He stated that acquisition of Delpark broadens the Commercial Filters line which provides micronic filtration for practically all industrial fluids.

A-C Names Parker Dir. Of Sales Promotion

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has announced the creation of a position as Director of Sales Promotion in Allis-Chalmers Industries Divisions.

Charles W. Parker, Jr., formerly manager of the company's Philadelphia district, was named to the position, which has been created to expand Allis-Chalmers scope of sales promotion in line with company growth.

Cathey Appointed District Manager By Bailey

Bailey Meter Company, Cleveland, Ohio, has announced that R. T. Cathey has been appointed district manager of the company's Dallas district. He succeeds F. D. Krusemark who has resigned.

A graduate of Clemson College, Cathey holds a bachelor of science degree in mechanical engineering. He joined Bailey Meter as a cadet engineer in 1947, and was assigned to the Charlotte, North Carolina district in 1948. In 1955 he was named an application engineer in the company's Pump & Paper Division.

Cathey's professional activities include membership in the ASME, the North Carolina Society of Engineers, the Charlotte Engineers, and TAPPI.

Arthur Lewis Joins Pennsalt

Pennsalt of Washington Division, Pennsalt Chemicals Corp., Tacoma, Wash., has announced the addition of Arthur J. Lewis to the sales staff.

Lewis, a graduate of Santa Clara College, joined Pennsalt upon release from active military duty. A native of Portland for 16 years, Lewis will continue his residence in that city where he will be assigned chemical sales office duties at Pennsalt's Portland plant, Mr. Shanaman stated.

James E. Etzel Joins Roy Weston, Inc.

Roy F. Weston, Inc., Newtown Square, Pa., has announced that Dr. James E. Etzel, formerly of E. I. du Pont de Nemours, has joined its staff. He will do research, development and process engineering. Dr. Etzel received his doctorate in sanitary engineering from Purdue University and since that time has been teaching and conducting work in industrial waste disposal.

How a Four-Man Crew laid 1500 feet a day of CLOW Bell-Tite® pipe through Florida swampland

CLOW cast iron pipe, with the sensational Bell-Tite joint, proved its advantages conclusively in this Clearwater, Florida, installation.

That a four-man crew was able to lay this CLOW Bell-Tite pipe at 1500 feet a day under these adverse conditions is definite evidence of the time, labor and money-saving advantages of this CLOW-designed joint. Two men worked in the trench—often in 3 feet of water. One man lubricating and aligning the joints, the other assembling with a pinch bar. A crane operator and a hook-up man completed the crew.

CLOW Bell-Tite forms a pressure-tight joint—instantly—no bolts or follower glands required. Under practically all conditions, it is the fastest, easiest and most economical pipe for water main installation. Underwriters' Laboratories Inc. listed in diameters 3- through 24-inch.

Shows simple assembly of CLOW Bell-Tite joint. Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

Under-water assembly of 8" Bell-Tite pipe at Clearwater, Fla.
Contractor: Hancock Pipe Company, Clearwater, Fla.

JAMES B. CLOW & SONS, Inc.

CLOW © 1878 ®

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

This air view of the City of Tacoma, Washington shows a portion of the industrial area in the foreground with the business district and Commencement Bay in the background. The detail illustration at right, shows a typical cluster of Crispin Air Valves in a Tacoma installation.

"...installed in 1913
...good for another 45 years..."

from Tacoma comes your proof that
Crispin AIR VALVES *are dependable!*

Here is your *advance* proof that Crispin Air Valves will give you dependable service *for years*. Mr. J. A. Kuehl, Superintendent of the Water Division, Department of Public Utilities, City of Tacoma, Washington puts it this way . . .

"It may be of interest to you to know that the City of Tacoma, Department of Public Utilities, Water Division, has been using Crispin Air Valves on its 40 miles of supply line since its inception during the year 1913. Maintenance on these valves has amounted to the replacement of seats and floats occasionally and they appear to be good for another 45 years of service."

Crispin Air Valves have these important advantages—simplified construction, easy accessibility, maximum durability, minimum maintenance and thoroughly efficient operation. The records of the City of Tacoma prove the value of these advantages.

We invite you to write, wire or phone our offices for detailed information on dependable Crispin Air Valves . . . your inquiry will receive prompt attention.

multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA
Dept. B

News of Suppliers

CONTINUED FROM PAGE 118A

Moore Supply Co. Named Sales Agent B-I-F

B-I-F Industries, Inc., Providence, R. I., has announced the appointment of Moore Supply Co., of Bolivar, N. Y., as a sales agent for certain of the products manufactured by Proportioneers, Inc., and Builders-Providence, Inc. The Moore organization will cover the territory of western New York bounded on the east by Wayne, Ontario, Yates, and Steuben Counties, including the cities of Rochester and Buffalo, as well as Erie, Warren, McKean, and Potter Counties in Pennsylvania.

Pennsalt Moves Corrosion Activities to Natrona

Pennsalt Chemicals Corp., Philadelphia, Pa., has announced the transfer of the sales department and research and development activties of the Corrosion Engineering Department to the Natrona, Pa., plant.

Manufacturing, sales, and development activities will all be centered in Natrona under the direction of Robert R. Pierce, currently Manager of the Corrosion Engineering Department and veteran of 16 years of plant, technical service, and sales management with Pennsalt.

Graver Forms New Departments

Graver Water Conditioning Co., N. Y., N. Y., has announced the regrouping of major sales areas and the formation of new departments. The new sales structure announced by the company covers the following fields: industrial, municipal and utility water treatment; industrial waste treatment; chemical processing; foreign operations, and process engineering. Managers have been named for each of them.

In the realigment, the sales engineering department has been replaced

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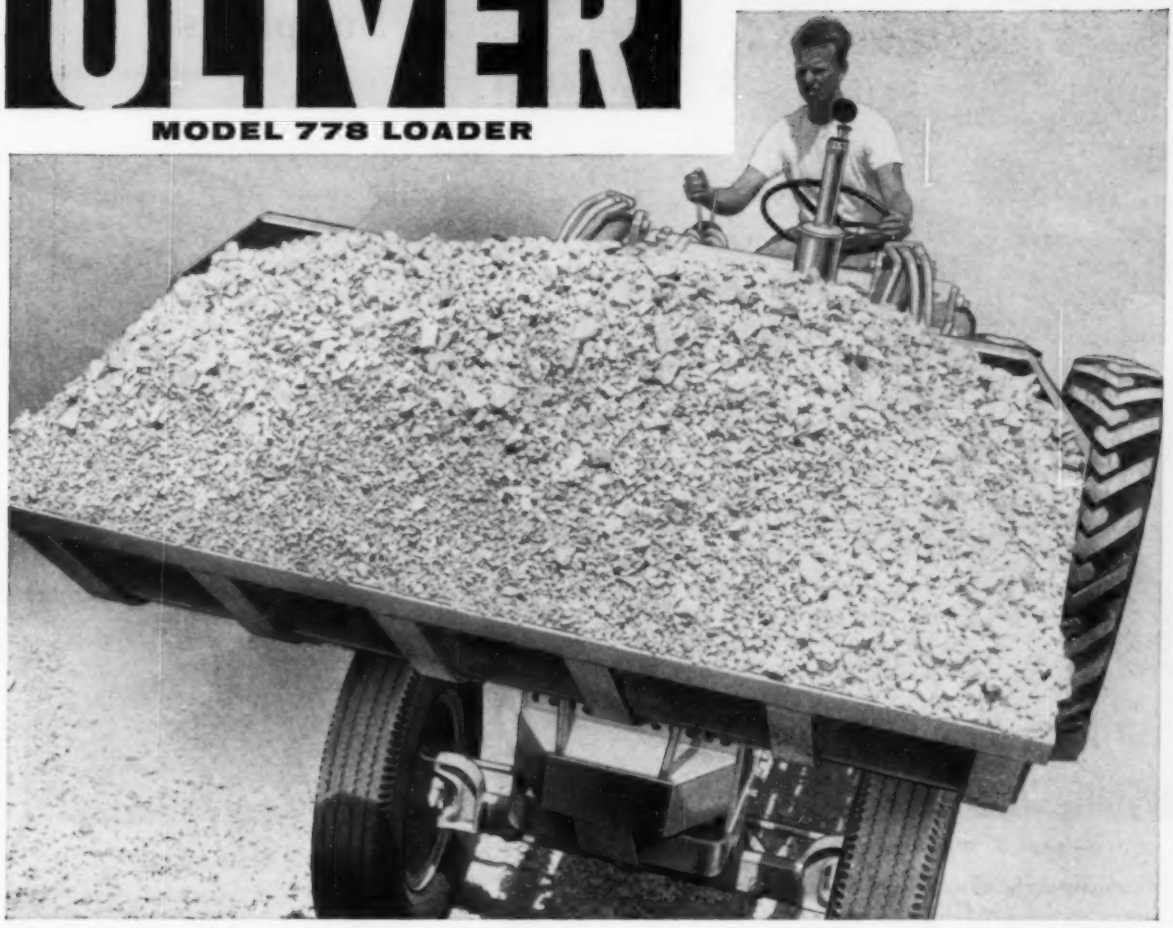
OLIVER

MODEL 778 LOADER



Want loads like this...every time, in quicker time?

Your head will turn so fast to watch this new Oliver 778 loader in action that you'll *know* loading costs are in for a tumble!

Advanced design does it! The 778 loader is the newest of new tractor-loaders—giving you "things to come" in wished-for operating speed, ease and stamina.

"Reverse-O-Torc" does it! Another reason this modest-priced tractor-loader gives you production equal to much higher priced 4-wheel drive units of similar capacity. No gear shifting...no clutching. A flick of the lever gives you forward or reverse instantly. A torque converter with fluid coupling does the power transmission work—smoothly, positively.

Non-tiring operation does it! The most practical application of hydraulics and the most simple controls keep operators performing at peak efficiency even in day-long, nonstop production loading.

Step into your Oliver distributor's for the details and a demonstration.

It moves faster, loads more. The most spirited performance you ever saw in the ¾-yd. rubber-tired tractor-loader. The Oliver 778 is built to back up this speed for years. It's full-framed—the loader is mounted front and back for maximum strength. New detent valve feature holds lift arms up or down...new float position allows bucket to follow ground contour with no digging-in...bucket leveler is automatic. Works with many other attachments and in combination with trencher.

OLIVER **THE OLIVER CORPORATION**

Industrial Division, 19300 Euclid Ave., Cleveland 17, Ohio

a complete line of industrial wheel and crawler tractors and matched allied equipment

"For tight spots and tough roots... nothing beats our Buckeye 403's!"

— says J. W. Cain, Sarnia, Ontario

Seventy-eight miles of service line and connections will soon bring natural gas to hundreds of thousands of Ontario residents. Handling the ditching is Contractor J. W. "Jim" Cain, a newcomer to Canada's booming pipeline industry.

"Our biggest obstacle is the hundreds of hardwood trees that line every residential street," says Mr. Cain. "That's why we've standardized on the Buckeye 403. It's the only machine I know that can maneuver quickly . . . yet has plenty of power to knife through thick roots. We own five Buckeye 403's. They've practically eliminated time-consuming stops where a hatchet or a shovel previously had to be used."

See for yourself! Your Gar Wood-Buckeye dealer demonstrates the 403 Utility Ditcher. Call him soon or write to: Customer Service Dept., Gar Wood Industries, Inc., Wayne, Michigan.

Gar Wood Excavators

Gar Wood Winches

Gar Wood–St. Paul Hoists & Bodies

Gar Wood INDUSTRIES, INC.

Findlay, Ohio • Wayne, Michigan

News of Suppliers

CONTINUED FROM PAGE 120A

by the process engineering department consisting of process engineers and sales engineers. They will work as a team in developing the best technical solution to the customer's problem and in obtaining any technical or engineering department assistance that may be required.

The former industrial water treatment department has been divided, with one department to have responsibility for power plant utilties and the other to deal with all other industrial applications.

Announced recently as part of this program was the formation of a chemical processing department to handle work in that field and a new foreign operations department to expand Graver representation and facilties in foreign markets. Rounding out the changes, the former advertising department has been renamed the sales promotion department and has been given additional responsibilities.

Herbert Ley Joins DeCelle & Assoc.

DeCelle & Associates, Chicago, Ill., has announced that Herbert H. Ley has become an associate of the firm.

Mr. Ley, a native of Marshfield, Wis., received his B.S. degree in Civil Engineering at University of Wisconsin in 1940 and took his first engineering job with Chicago Pump Co. In 1946, he resigned as Manager of their Sewage Equipment Application Dept. to join Consoer, Townsend & Associates, Consulting Engineers, Chicago. When he left CT&A he was an Associate in charge of Sanitary Engineering.

He is a member of the American Society of Civil Engineers and a member of the American Academy of Sanitary Engineers.

Permutit Acquires Bulkley-Dunton Flotation Dept.

The Permutit Division of Pfaudler Permutit Inc., New York, N. Y., has the acquisition of the flotation equip-

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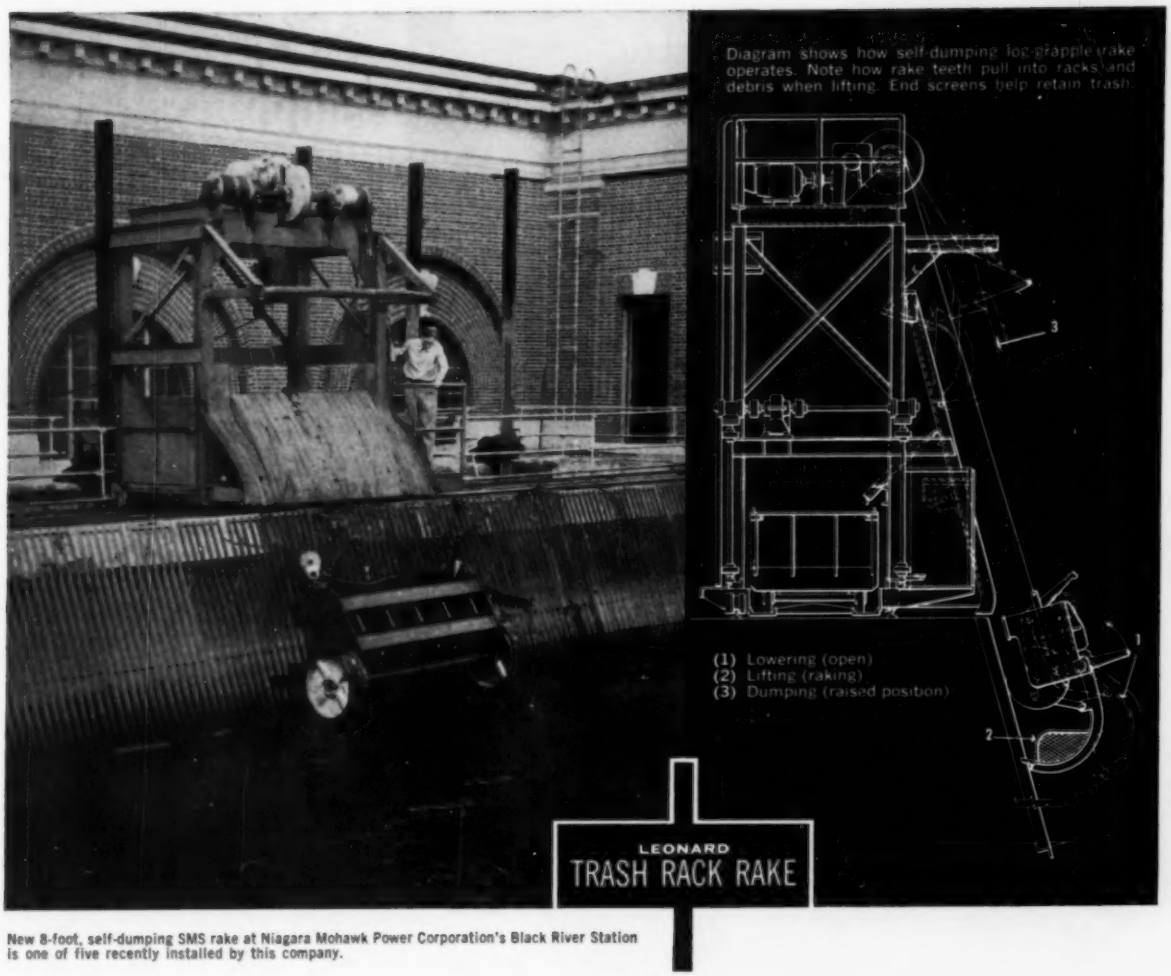
Diagram shows how self-dumping log-grapple rake operates. Note how rake teeth pull into racks and debris when lifting. End screens help retain trash.
(1) Lowering (open)
(2) Lifting (raking)
(3) Dumping (raised position)
1
2
3
LEONARD
TRASH RACK RAKE

New 8-foot, self-dumping SMS rake at Niagara Mohawk Power Corporation's Black River Station is one of five recently installed by this company.

Two New Self-Dumping SMS Trash Rake Designs CUT CLEANING TIME AND LABOR

Now SMS offers you two improved Leonard trash rack rakes, both regular and log-grapple types. These self-dumping rake designs make operation easier and quicker, permit you to clean a greater area faster. Both new rake types are now available as additions to the SMS line of standard rake designs.

SMS Leonard rakes operate directly on trash rack bars . . . ride down over stubborn obstructions and work them loose. Such freedom of movement assures fast, easy cleaning. Initial costs are low because the width of SMS rakes can be kept to the minimum required for handling for trash and the expense of guides attached to racks, or embedded in piers is eliminated. These rakes are of simple and rugged construction, designed for outdoor service and require minimum maintenance.

For full information on trash rakes and other SMS accessories, write to S. Morgan Smith Co., York, Penna. Request Bulletin 158 on Leonard rakes, or Bulletin 158A on new, self-dumping rakes.

SMS
S. MORGAN SMITH
HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

Where water is used, process equipment and storage tanks are sure to corrode unless protected by an E.R.P. cathodic protection system. Even with these concrete high rate clarifiers at the St. Regis Paper Company plant near Jacksonville, Florida, it pays to protect the metal parts with an E.R.P. cathodic system.

Engineering PLUS...
E.R.P. cathodic protection pays off in maintenance savings

In industry or public service, water treatment is a big investment. To protect that investment in water treatment equipment could be a tremendous maintenance job. Even with concrete clarifiers, it pays to use E.R.P. cathodic protection. When there are metal tanks involved, just one cleaning and painting can cost more than a complete E.R.P. cathodic protection system.

From preliminary design to continuing periodic corrosion surveys, experienced corrosion engineers measure, analyze and design specifically for your corrosion problems. That is the only way corrosion can be virtually eliminated.

E.R.P. engineering plus prevents corrosion of water storage tanks, water and sewage treatment structures and pipelines. For full information on how E.R.P. can help you save maintenance costs, write for bulletin E-42.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

News of Suppliers

CONTINUED FROM PAGE 122A

ment business owned by Bulkley-Dunton Pulp Co., Inc. The purchase includes the trade mark and manufacturing rights for the "Collidair Separator" developed by Bulkley-Dunton Processes Inc. and used for clarification of process waste liquids and recovery of materials in liquid suspension.

Gregory Klebanoff, formerly with Bulkley-Dunton Processes, will be in charge of sales of Permutit flotation equipment including the Colloidair Separator, under the supervision of Charles G. Bueltman, Manager of Permutit's Industrial Waste Treatment Department which handles all Permutit equipment for waste treatment.

Hersey Opens New Chicago Headquarters

Hersey Mfg. Co., Dedham, Mass., has announced the opening of new Chicago headquarters at 4935 West Belmont Ave.

The new 3,000 square foot headquarters building houses facilities for sale, warehousing and shipping of company's water meters. Hersey Manufacturing Company, which produces one of the most complete line of water meters in the nation, will observe its 100th anniversary next year. Its general offices and principal plant are located in Dedham, Mass.

Michael H. Foley, a thirty-one-year veteran with the company, is manager of the Chicago branch. Eleven persons are employed at the headquarters.

S. Morgan Smith Appoints New Representatives

The Valve Division of The S. Morgan Smith Co., York, Pa., has just announced additions and revisions in the organization's group of sales representatives.

Representation will be as follows in these territories: in the Chicago area, Frabimor Equipment & Controls Co., Inc., of Chicago; In West Virginia and adjoining counties of Maryland, Ohio and Kentucky, Process Instru-

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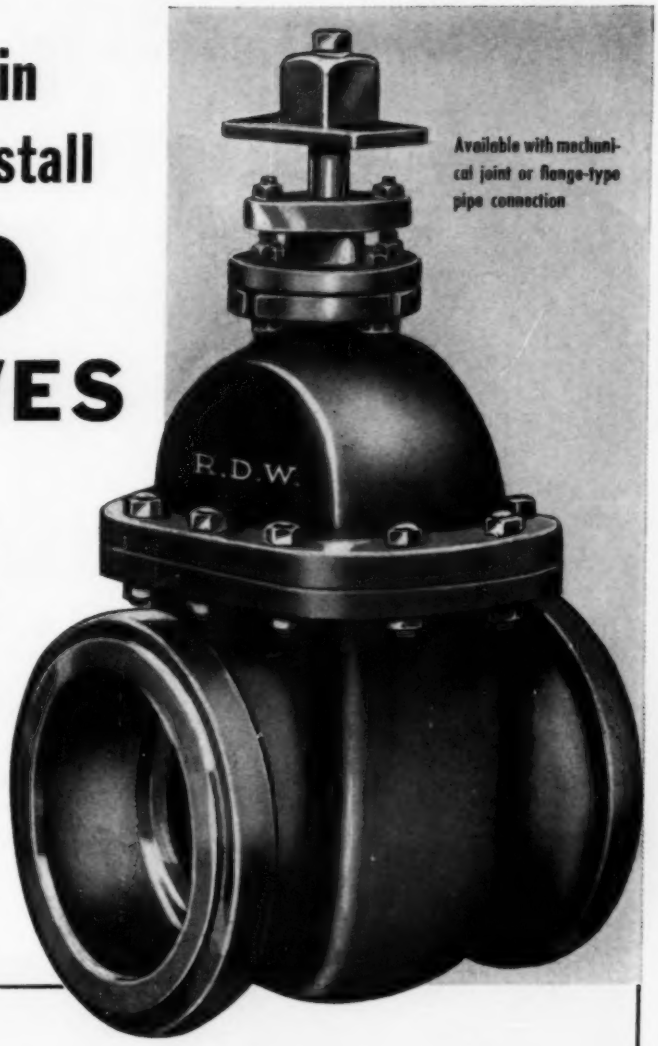
No interruptions in service when you install

WOOD GATE VALVES



Available with mechanical joint or flange-type pipe connection

Because of their inaccessibility underground, repairs to gate valves are always time-consuming, expensive, and a source of annoyance. And interruptions in service while repairs go on are hazardous for the community.

For these reasons, R. D. Wood Gate Valves are designed to function for generations no matter what the conditions. They are rugged in construction, fully bronze mounted, and tested to 300 lb. hydrostatic pressure. Designed for working pressures conforming to AWWA specifications.

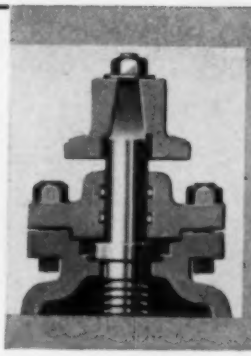
SIMPLE IN DESIGN

Only three moving parts—a spreader and two discs which are free to revolve their complete circumference while being raised or lowered. Gates are lifted clear of valve seats, providing unobstructed flow.

R. D. WOOD COMPANY

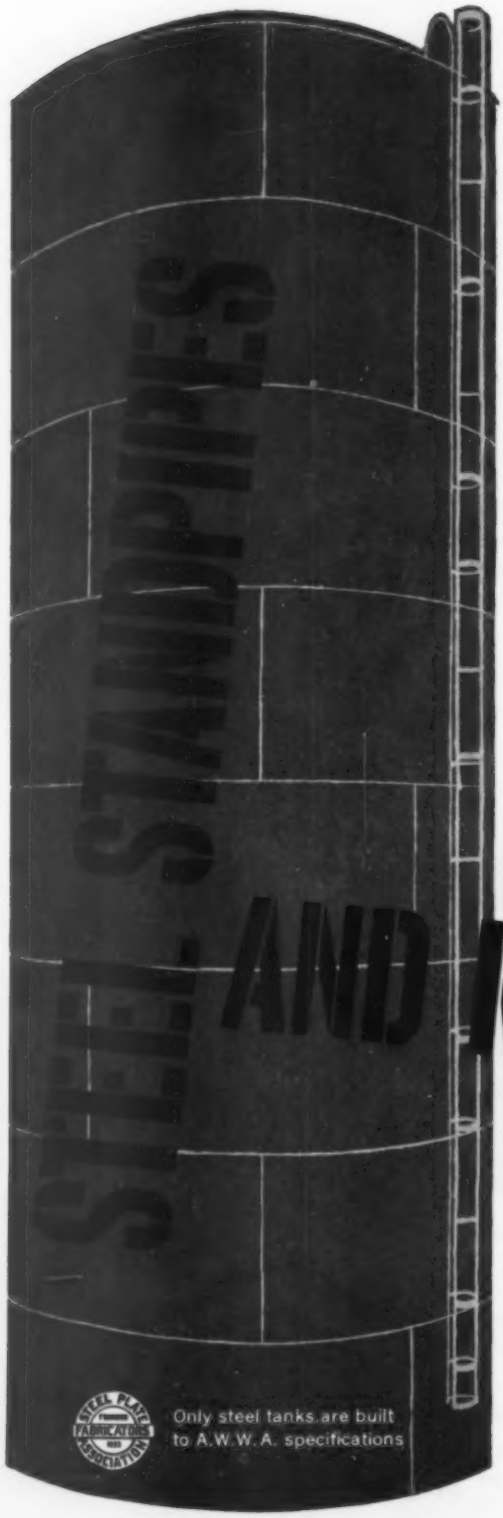
Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)



R. D. Wood Gate Valves also available with O-Ring Stuffing Box seal when specified.

It pays to plan with General American


STEEL STANDPIPES
AND RESERVOIRS
STEEL PLATE FABRICATORS ASSOCIATION
Only steel tanks are built to A.W.W.A. specifications

Any Required Capacity! Erected Anywhere!

From its plants in Pennsylvania, Alabama, Indiana and Utah, General American supplies water storage facilities rapidly, efficiently and inexpensively.

The Field Erection Division maintains experienced crews and modern, efficient erection equipment throughout the country. No matter where you are, you are assured of immediate action and workmanlike construction.

General American steel reservoirs and standpipes are designed for lifetime trouble-free service. Our architects and engineers design exterior treatments to give them a clean modern appearance as well as utility.

Steel storage systems are elastic to protect against cracks when settling occurs, are not damaged by the action of frost, are lightweight, porosity-free, cost less to build and less to maintain than other types.

Your inquiries are invited.

GENERAL AMERICAN

Plate and Welding Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street · Chicago 90, Illinois

WHAT'S BEST IN CHEMICAL FEEDING?

PRECISION

Throughout the water conditioning industry, "S Treatment" has come to mean operating dependability and precision proportioning. A positive displacement, diaphragm pump, the Model S features chemically resistant, fibre-tough construction. Simplicity of solution handling parts, foul-resistant valve design produce accurate and consistent pumping. A rugged motor and gear train, immersed in oil, insure long life.

With the Model Sulphuric Acid, Precision pumps will handle virtually all water treating chemicals . . . from hypochlorites and soda ash to concentrated sulphuric acid . . . in ranges between 0 and 15 g.p.h. All pumps are covered by an unconditional, one year guarantee.

For further information, write Department 1A, Precision Chemical Pump Corporation, 1396 Main Street, Waltham 54, Massachusetts.

"THE STANDARD FOR CHEMICAL PUMPING"

chlorination ●

pH control ●

fluoridation ●

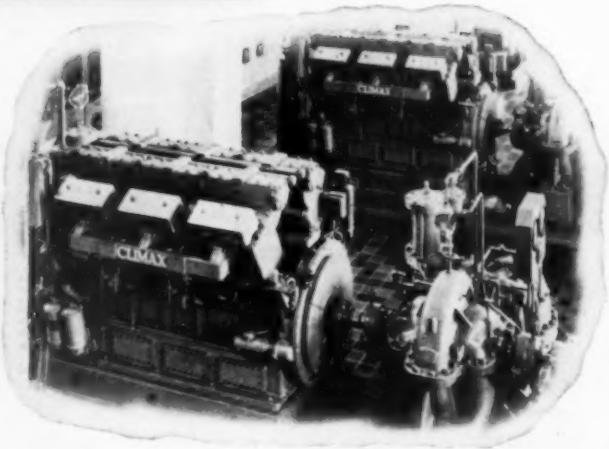
corrosion control ●

PRECISION CHEMICAL PUMP CORPORATION

1396 MAIN STREET • WALTHAM 54 • MASSACHUSETTS

WHEN YOU BUY CLIMAX...

You Buy Years of Money Saving Service



Two Climax V-120 Gasoline Engines driving 10-mgd. high lift pumps at Evanston, Ill.

CLIMAX GAS, GASOLINE or BUTANE ENGINES—6 cylinder to V-12, 40 to 605 hp. (max.) at 1200 rpm.

ASK ANY CLIMAX OWNER:

1. How his conservatively rated engine matches *all* the requirements of his job...supplies plenty of reserve power when needed...and just keeps on working year after year, paying for itself in minimum attention, trouble-free operation and low fuel cost..
2. About the operational simplicity of his engine... the handy location of controls and accessories ...convenient accessibility to working parts ...and the many other long-standing features that have made Climax famous for easy routine maintenance.
3. About distributor service—how his Waukesha-Climax Distributor has saved him time, trouble and money...first, by recommending just the right model for the job...second, by insuring proper installation...and third, by keeping in close personal touch with 24-hour service, skilled mechanics and factory parts.

Your Waukesha-Climax Distributor will be glad to tell you about Climax owners in your area. Ask him for names and facts...also for recommendations on the particular Climax Engine that will give *you* years of money saving service.

WAUKESHA-CLIMAX DISTRIBUTORS

EAST
Maryland: Baltimore
Massachusetts: Buston, Fair Haven
New York: Buffalo, New York City
Pennsylvania: Clearfield, Philadelphia, Pittsburgh
Virginia: Richmond
West Virginia: Bridgeport, Charleston

SOUTHEAST
Florida: East Tampa, Jacksonville, Miami
Georgia: Atlanta
North Carolina: Charlotte, Fayetteville

MIDWEST
Illinois: Chicago, Grayville
Indiana: Indianapolis
Iowa: Waterloo
Kansas: Great Bend, Kansas City, Wichita
Kentucky: Lexington
Michigan: Detroit
Missouri: St. Louis
Nebraska: Omaha
Ohio: Cincinnati, Cleveland, Columbus
Wisconsin: Green Bay

SOUTH CENTRAL
Alabama: Birmingham
Louisiana: New Orleans
Mississippi: Natchez
Tennessee: Memphis, Nashville

SOUTHWEST
Arizona: Phoenix
Louisiana: New Iberia, Shreveport
New Mexico: Hobbs
Oklahoma: Duncan, Seminole, Oklahoma City
Texas: Abilene, Corpus Christi, Dallas, Houston, Kilgore, Odessa, Pampa, San Antonio, San Juan, Wichita Falls

ROCKY MOUNTAIN
Colorado: Denver
Idaho: Boise
Montana: Great Falls
New Mexico: Farmington
North Dakota: Williston
Utah: Blanding, Salt Lake City
Wyoming: Casper

WEST
California: Avenal, Bakersfield, Castaic, Emeryville, Los Angeles, Santa Maria, Taft, Eureka, Ventura

NORTHWEST
Oregon: Portland
Washington: Seattle

ALASKA
Anchorage

CANADIAN DISTRIBUTORS IN:
Edmonton, Alb., Montreal, Que., Toronto, Ont., Vancouver, B.C., Winnipeg, Man.

CLIMAX ENGINE MANUFACTURING CO.
• DIVISION OF WAUKESHA MOTOR COMPANY •
FACTORY—CLINTON, IOWA

New Vistas

DURING this past year we have continued to manufacture and place in operation Coilfilter installations at the same heavy pace as for the previous 4 years.

As in 1957 a large percentage of this work is repeat order business; Consulting Engineers who have used our equipment have come to realize the performance that is built into the Coilfilter design and the high caliber of service rendered by our field crews.

As far as research is concerned most of this has been of a practical nature in inquiring further into the possible advantages, and drawbacks, of fresh solids dewatering. Actual operating experience in the field has been very good and the question of pathogenicity has been largely resolved. Material on this phase of our work will be reported in Technical Publications and promises to be the next big advance in the practice of Sanitary Engineering.

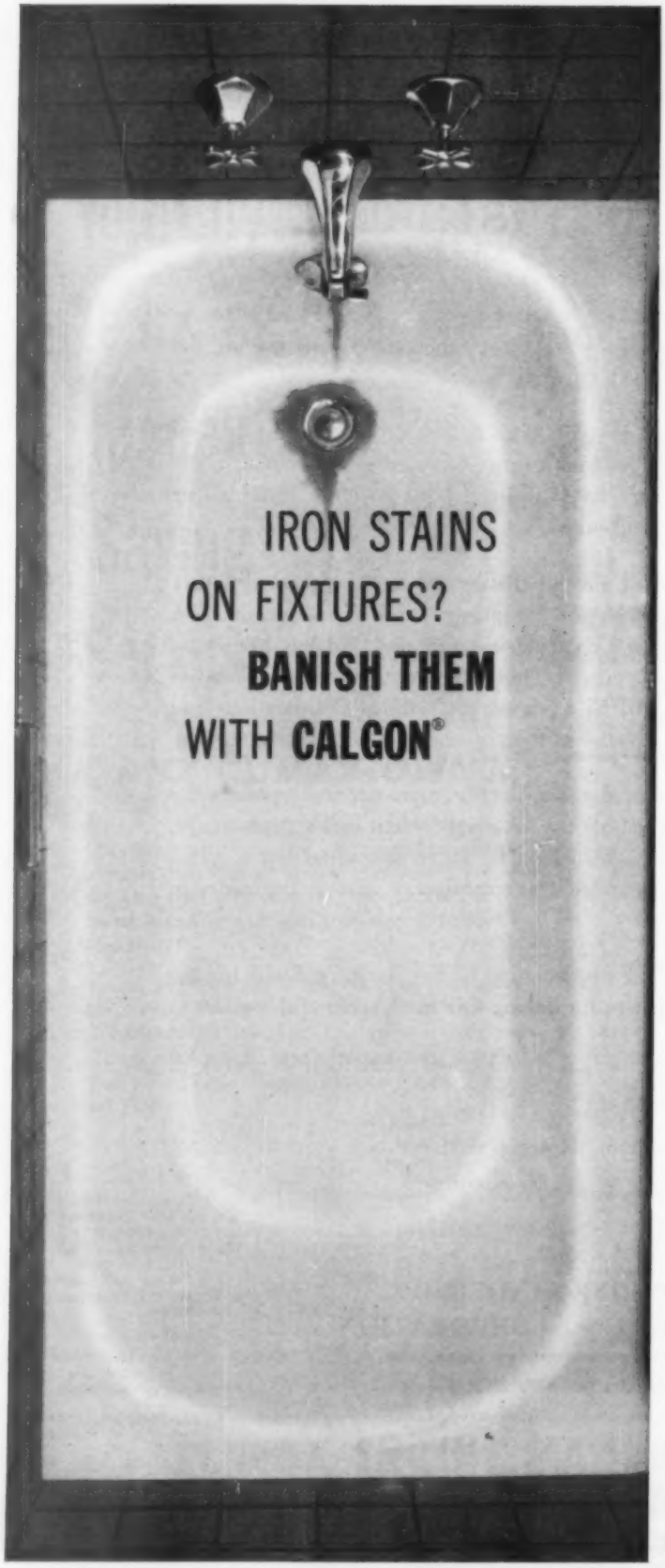
We are pleased to know that the auxiliary equipment developed by us through the years, involving mainly the chemical feeders and sludge pumps, is operating with complete satisfaction in numerous installations. This phase of our activity has generated more confidence among Engineers in mechanical dewatering.

Again we wish to express our appreciation to the Sanitary Field for the work we have been permitted to do during this most successful year.

As far as the future is concerned, it would appear that there is plenty of work for those who lead.

Respectfully,
T. R. Komline

KOMLINE-SANDERSON
ENGINEERING CORPORATION
MANUFACTURERS OF THE COILFILTER
PEAPACK, NEW JERSEY



Iron stains on plumbing fixtures . . . rusty streaks and spots on sheets and linens . . . small wonder housewives complain. But city officials can turn complaints into compliments by adopting Threshold Treatment* with Calgon.

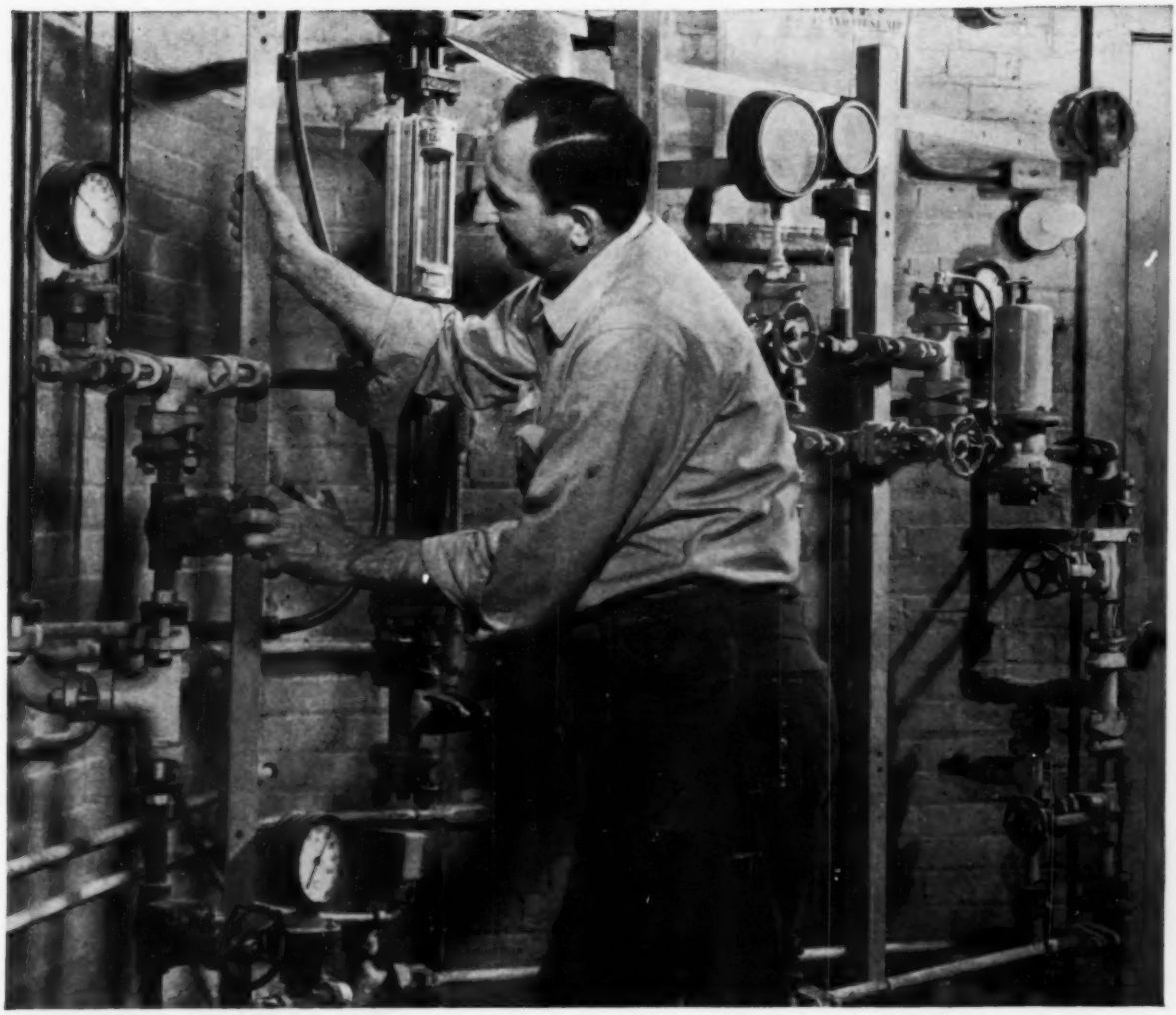
Calgon is the least expensive and most convenient way of stopping dissolved iron and manganese from discoloring water . . . staining fabrics and fixtures. Used in threshold amounts (2 to 10 ppm), Calgon's sequestering and dispersing action stops the precipitation of dissolved iron and manganese often present in well waters. Calgon's film forming ability protects pipe lines, reduces corrosion and maintains pipe line capacity.

An experienced Calgon engineer will be glad to work with you on the solution of your particular water problem. Write or phone the address below:

CALGON COMPANY

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

*U.S. Patents 2,337,856 and 2,304,850.



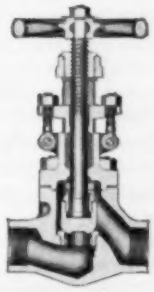
Crane Chlorine Valve Passes 10th Repair-Free Year on Chlorine Gas Throttling

Every time an operator opens or closes the Crane chlorine valve shown above, the Bergstrom Paper Company, Neenah, Wisconsin, is paid another dividend on an investment in service made more than 10 years ago!

This Crane No. 1644 forged steel globe valve is designed especially for chlorine gas or liquid service. In the Bergstrom plant it is used as a throttling valve to control and regulate chlorine gas pressure.

With the exception of a change-over to Teflon packing, this valve has needed no maintenance or repairs in ten years. It operates easily and closes tightly, and permits accurate, close, and safe control of chlorine gas. The record of this and other Crane chlorine valves has led the Bergstrom mill to standardize on the No. 1644 for all chlorine handling.

Ask your Crane Representative about this and other lines of Crane valves for handling hazardous and corrosive chemicals and liquors in your mill.



This rugged forged steel chlorine valve has Hastelloy "C" trim and Teflon packing. Globe or angle patterns; screwed or flanged ends.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

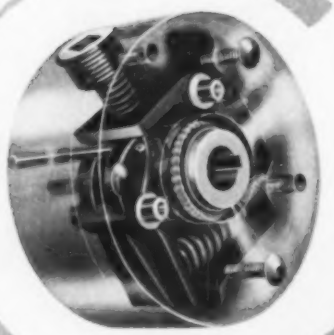
Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

For complete drive control and protection in

PUMPING STATIONS
GRID COLLECTORS
RECTANGULAR COLLECTORS
WATER TREATMENT EQUIPMENT

- - with Centric Clutches and Clutch-Couplings, specially designed for Water and Sewage Plants.

Avoid overload damage in rectangular and grid collectors and in water treatment equipment - - cut time down to minutes - - prevent costly chain breaks - - eliminate troublesome shear pins - - avoid need of draining tanks.



CENTRIC "TRIG-O-MATIC" OVERLOAD RELEASE CLUTCHES

are mechanical torque limiting devices that automatically **shut off the drive - - sound and alarm, when overloads occur - - before trouble can happen.**

Action is instantaneous, positive. Down-time is reduced to minutes, just long enough to locate the overload and to set the drive to running position.

"Trig-O-Matics" are fool-proof, non tamperable. They are service free units that do not require lubrication — do not require adjustment.

Are delivered as complete units - - ready to install with flexible couplings (shaft-to-shaft), sprockets, pulleys, sheaves and gears. There are no extras to buy.

Standard design "Trig-O-Matics" have a capacity range from 7 lbs. to 30,000 lbs.

Gain positive power-drive control for pumping stations and water treatment plants. Protect equipment by smooth, gradual starts without shocks; accelerated running loads. Provide independent operation on dual drives.

GENTRIC TYPE A SPRING CONTROLLED CENTRIFUGAL CLUTCH COUPLINGS

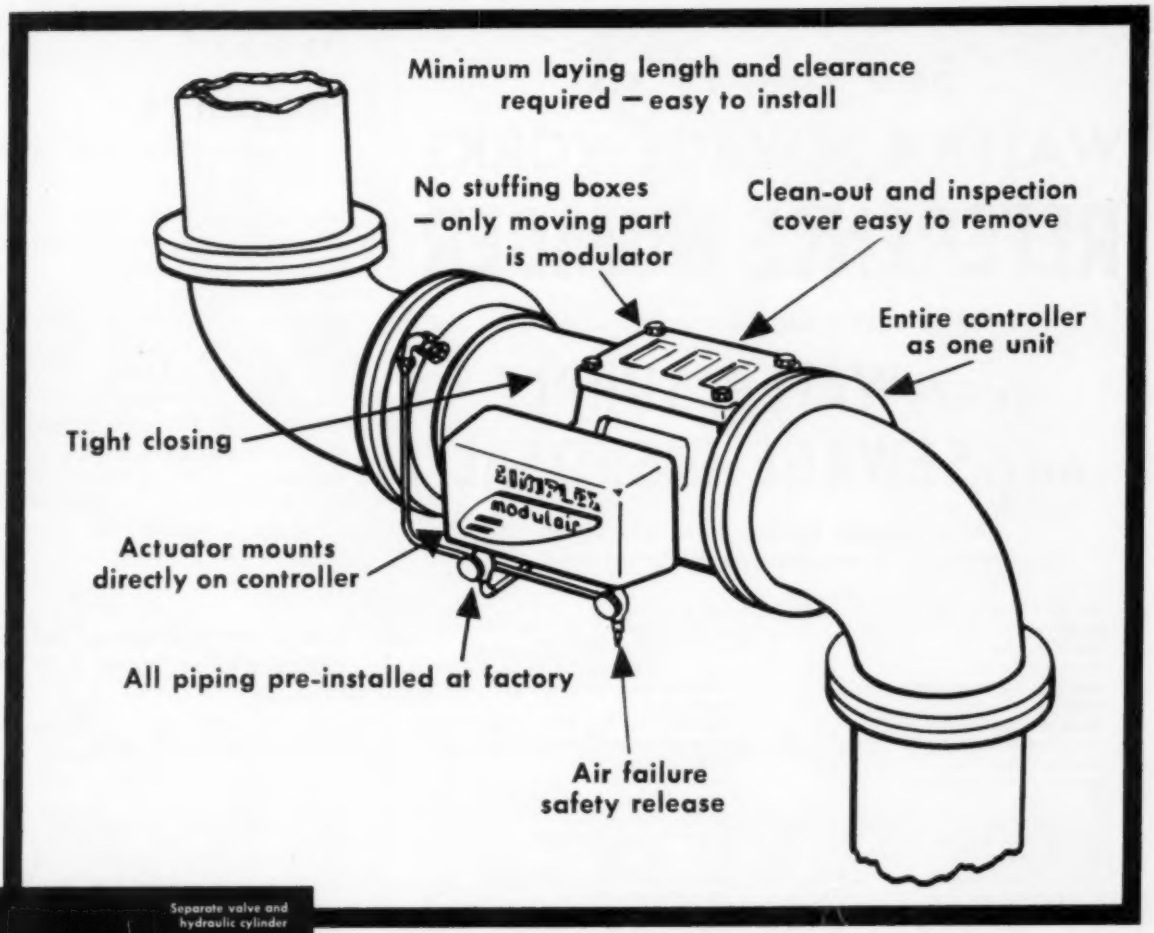
For dual drives, either side can be started at will independently of the other. This type of clutch-coupling permits warm-up at the predetermined speed. Thus the engine or turbine can idle without operating the driven member. It automatically picks up the load whenever the engine or turbine speeds up and engages at any predetermined speed.

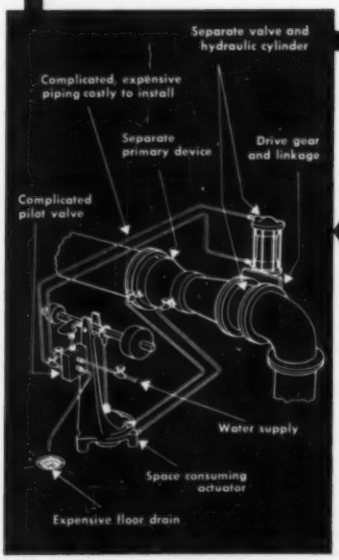
Capacities range from 1 H.P. to 2500 H.P. based on operating speed.

Send for Bulletins 302 and 304 completely describing these clutches and clutch-couplings.

CENTRIC *Clutch Company*

P. O. BOX 175 • U. S. ROUTE 9 AT MAIN STREET • WOODBRIDGE, N. J.


Minimum laying length and clearance required — easy to install
No stuffing boxes — only moving part is modulator
Clean-out and inspection cover easy to remove
Entire controller as one unit
Tight closing
Actuator mounts directly on controller
All piping pre-installed at factory
Air failure safety release
SIMPLEX
modulair



COMPARE and see how new Modulair® Flow Controller makes this design obsolete

best of all . . .

Simplex Modulair saves you money three ways

During 6 years of extensive use, the Modulair Rate of Flow Controller has proved time and time again that it can save money three ways:

1. Its unit construction makes it your best buy on a first cost basis.
2. You save installation time and money. Modulair is as easy to install as a piece of pipe.
3. Maintenance is practically nil, because of Modulair's exceptionally simple design.

If all this interests you, write for our Bulletin 951.

SIMPLEX®

VALVE AND METER COMPANY

LANCASTER, PENNSYLVANIA

See the 1958
WATER & SEWAGE WORKS
REFERENCE NUMBER

For the latest complete information

about **WATER SUPPLY**
and **SEWAGE DISPOSAL**

These industry leaders have interesting, informative messages in this great issue:

Ace Pipe Cleaning Co.
Alabama Pipe Co.
Allis-Chalmers
Amercoat Corp.
American Vitrified Products Co.
American Well Works
Anthracite Equipment Corp.
Bailey Meter Company
Beaumont Birch Co.
Bethlehem Steel Company
B-I-F Industries, Inc.
Blackburn-Smith Mfg. Co., Inc.
Borden Metal Products Co.
Bremer Brease, Inc.
Builder-Providence, Inc., Div. of B-I-F Industries, Inc.
Chain Belt Company
Chicago Bridge & Iron Company
Chicago Pump Company
Climax Engine Co.
Clow, Jas. B. (Iowa Valve Co.)
Columbia Southern Chemical Div.
Combustion Engineering, Inc.
Cook Well Strainer Co.
DeZurik Corp.
Dorr-Oliver Inc.
Eimco Process Engineers, Inc.
Fine Organics, Inc.
Fischer & Porter Co.
Foster Engineering Co.
Frontier Chemical Co.
General Chemical Div. Allied Chemical Corp.
General Filter Co.
Golden Anderson Valve Specialty Co.
Graver Tank & Mfg. Co., Inc.
Graver Water Conditioning Co.
Hamilton Kent Mfg. Co.
Hardinge Company, Inc.
Infilco Inc.
International Minerals & Chemical Corp.
Iowa Valve Co.
Jeffrey Manufacturing Company, The
Johns-Manville
Jones Co., John Wiley
Komline-Sanderson Engineering Corp.
Link-Belt Company
Ludlow Valve Mfg. Co., The
M & H Valve & Fittings Company
Merrick Scale Mfg. Co.
Multiplex Manufacturing Co.
Natco Corp.
National Clay Pipe Manufacturers, Inc.
National Power Rodding Corp.
Neptune Meter Co.
Nichols Engr. & Res. Corp.
Olin Mathieson Chemical Co.
Omega Machine Co., Div. of B-I-F Industries, Inc.
Pacific Flush Tank Co.
Pennsalt Chem. Corp. (West Div.)
Permutit Company
Phelps Dodge Refining Corp.
Philadelphia Quartz Co.
Phipps & Bird, Inc.
Pittsburgh-Des Moines Steel Co.
Pratt, Henry, Co.
Precision Chemical Co.
Preload, Inc.
Proportioneers, Inc., Div. of B-I-F Industries, Inc.
Rensselaer Valve Co.
Roberts Filter Mfg. Co.
Robinson Pipe Cleaning Co.
Schramm, Inc.
Shahmoon Industries, Inc.
Simplex Valve & Meter Co.
Smith-Blair, Inc.
Smith & Loveless, Inc.
Smith Mfg. Co., A. P.
Standard Steel Corp.
Tennessee Corporation
U. S. Pipe & Foundry Co.
Vulcan Materials Co.
Walker Process Equip. Inc.
Wallace & Tiernan, Inc.
Washington Aluminum Co.
Water Seals, Inc.
Wheeler Mfg. Co., C. H.
Wheeler Mfg. Corp., The
White Diesel Eng. Div.
Worthington Corp.
Yeomans Brothers Co.

SCRANTON PUBLISHING CO., INC.
185 N. Wabash Ave., Chicago 1, Ill.
155 E. 44th St., New York 17, N. Y.

News of Suppliers

CONTINUED FROM PAGE 124A

ment & Equipment Company of Charleston, West Virginia, and in Maryland and Virginia, Jobe & Co. of Baltimore, Maryland. Ramon I. Gil of Santurce, Puerto Rico, represents Smith in Puerto Rico, the Dominican Republic and the Virgin Islands.

Continuing to represent the Smith Company, with intensive concentration in their territories, are: Bradshaw & Company of Pittsburgh, in western Pennsylvania, and Fluid Controls Company of Philadelphia, in eastern Pennsylvania, southern New Jersey and Delaware.

F & P Names Regional Sales Managers For Water & Waste Dvision

Fischer & Porter Co., Hatboro, Pa., has announced that Thomas A. Rose and Richard H. Kutsch have been named Regional Sales Managers for the Water & Waste Division.

Thomas A. Rose joined F & P in 1951 as field engineer in the Philadelphia sales office handling all of the company's products. In 1953, he was made District Manager of the Chicago Chlorinator Division.

Richard H. Kutsch began his sales career with F & P by establishing the Charlotte District office in early 1954. His sales ability was especially outstanding in the field of municipal selling and resulted in this new assignment.

Lube Jack Co. Changes Name

Earthworm Boring Machine, Inc. is the new name for Lube Jack Company, Santa Monica, Calif., manufacturers of the Earthworm Boring Machine, a portable, horizontal boring unit for underground installation of pipe and conduit.

There will be no change in personnel. R. S. Johnson is President of the company, and R. M. Link is Manager. An expanded advertising and sales campaign is now being prepared and will be activated in the Fall, according to Mr. Link, who states that the company's sales are running well ahead of the same period last year.

CASE HISTORY: How Badger PRP* helps communities meet rising costs without raising rates.

* *Planned Rehabilitation Program helps city*

account for 94% of water used

through annual "roundup" of defective meters

A near impossible record — but this Midwestern city did it! The community (name on request) began metering when it started its water system back in 1882. One of the nation's first cities to be fully metered, it initiated a planned meter rehabilitation program at the outset. Result: low water waste, high water revenue — as much as 94% of *all* the water used is "accounted for."

Badger's Planned Rehabilitation Program has helped communities all over the country keep their water systems on this same profitable basis. They're installing new, accurate Badger meters where it is economically feasible... new essential parts where only minor repairs are needed.

Is your water department paying its way?

If not, it's time your community held its own water meter roundup — to open the way to new revenue . . . end water waste from worn-out meters and parts . . . even help meet rising water department costs. Send for free booklet, "Take 5," outlining the 5 steps to increased revenue through Badger's Planned Rehabilitation Program.

And be sure to ask your Badger representative about our liberal water meter trade-in policy.

Badger Water Meters

BADGER METER MFG. CO. • 4545 W. Brown Deer Rd.
Milwaukee 18, Wisconsin

Research makes the big difference in meters Badger builds...

New features for water meters are constantly being developed and tested in Badger's engineering and research departments. Here a chemist inspects plastic specimens tested for dimensional stability. To his right, a test of registers operating under water determines corrosion resistance . . . and an electrolytic analyzer is making a quantitative analysis. From these tests and others will come still greater efficiency and proven durability for future water meters—first from Badger.

BADGER METER MFG. CO.
Dept. C-1, 4545 W. Brown Deer Rd.
Milwaukee 18, Wisconsin

Gentlemen:
Please send me your free booklet, "Take 5."

Name_____

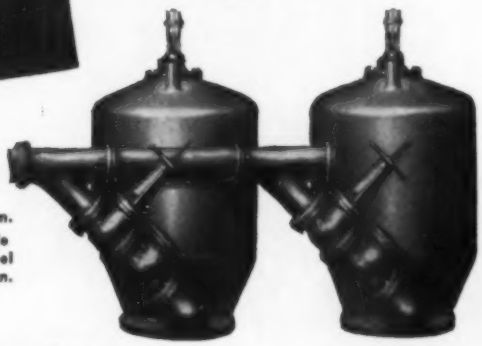
Title_____

Address_____

City_____ State_____

The Simple, Inexpensive, Rugged, Dependable means of Lifting Sewage

KOMLINE-SANDERSON
Pneumatic
Sewage Ejectors



Illustrated: Cast iron duplex 250 GPM system.
K-S Ejectors are available in cast iron or welded steel in single or duplex design.

The Komline-Sanderson Ejector:

Eliminates complex and intricate piping.
Provides economical operating features.
Offers electric or entirely pneumatic control system.

Write for catalog giving layout dimensions, piping diagrams and helpful information in the design of pneumatic ejector stations.
Bulletin No. KSM-2 available on request.

MECHANICAL EQUIPMENT DIVISION
KOMLINE-SANDERSON ENGINEERING CORPORATION
102 Holland Avenue, Peapack, New Jersey

GUNITE does it **2** times as fast at **1/2** the cost

"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
- Dams
- Filter Plants
- Sewage Disposal Plants
- Tanks
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools, etc.

Write FOR MORE INFORMATION, INCLUDING 48 PAGE "GUNITE" BOOKLET.

PRESSURE Concrete Co.
FLORENCE, ALA. 1555 Helton Street

OTHER OFFICES IN
CHICAGO, ILL. 30 W. Washington Street
NEWARK 5, N. J. 193 Emmet Street

Helpful Bulletins

Water Filtration Plant Catalog

1035

Dresser Mfg. Div., one of the Dresser Industries, Inc., Bradford, Pa., has just published a new Water Filtration Plant Catalog.

Pneumatic Sewage Ejector

1036

The Mechanical Equipment Division of the Komline-Sanderson Engineering Corp., Peapack, New Jersey, has just published a new 14-page, two-color, illustrated catalog on the Komline-Sanderson Pneumatic Sewage Ejector systems.

Municipal and Industrial Sanitation

1037

Dorr-Oliver, Inc., Stamford, Conn., has announced the availability of a new four-page, two-color bulletin entitled, "Seven Developments for Municipal and Industrial Sanitation."

Sewage Treatment Catalog

1038

Dresser Mfg., one of the Dresser Industries, Inc., Bradford, Pa., has just released a new Sewage Treatment Plant Catalog.

Low-Cost Geared Coupling

1039

Link-Belt Co., Chicago, Ill., has just released a folder describing their new, low cost MC geared coupling. The folder details pertinent application and selection data for the new MC couplings, which are designed especially for use as a motor coupling—for transmitting electric motor power to pumps, generators, speed reducers, etc.

Separators and Thickeners

1040

Chain Belt Co., Milwaukee, Wis., has just published a bulletin on the Rex Foat-Treat Separators and Thickeners.

CONTINUED ON PAGE 138A

recipe for trouble-free valving:

Just add water...

DeZurik Valves need no other ingredient to provide top operation in your plant! They close tight . . . open easily . . . last longer . . . with no need for lubrication, no special care of any kind!

CHECK THESE EXTRA FEATURES:

- Nickel seats that last and last
- Exclusive Eccentric Action
- Dead-tight shut-off in spite of solids
- Always operate easily
- Nickel alloy stem bushings
- Rugged construction

Available in sizes ½" thru 20", with manual or a full range of remote operators. Representatives in all principal cities, or write for details.

DeZURIK CORPORATION
SARTELL, MINNESOTA

LIFT MORE SEWAGE FOR LESS MONEY

Compact ejector system, motor compressor assembly and all controls in one "packaged" unit. Also made in twin units.

60 YEARS OF EXPERT KNOW-HOW

CALL ON

BLACKBURN-SMITH

Hundreds of pump and lift stations giving uninterrupted service with "B-S" Pneumatic Sewage Ejectors, single or twin units. Capacity 30 to 500 g.p.m. Heads up to 150 ft. No complex piping, screens, impellers, shredders, etc. Lowest installations, operating, maintenance costs.

WRITE FOR CATALOG S-55

Shows application, advantages, dimensions and layouts of B-S Pneumatic Sewage Ejectors, single and duplex units. Describes exclusive features of float, electric and pneumatic controls. Tells how to select proper size ejecto..

BLACKBURN-SMITH MFG. CO., INC.
51 GARDEN ST., HOBOKEN, N. J.
Oldfield 9-4425
N. Y. Tel. BArclay 7-0600

Helpful Bulletins

CONTINUED FROM PAGE 136A

Circular Slide Rule

1041

General Industrial Co., Chicago, Ill., has just introduced a handy circular Slide Rule for engineers and for other plant and office executives. Any executive who must perform simple calculations will find this convenient, pocket-size calculator extremely useful in his work.

Bellows Flow Meter

1042

Minneapolis - Honeywell Regulator Co., Industrial Div., Philadelphia, Pa., has just published a specification sheet that describes in detail the construction and operation of the Honeywell Bellows Meter for flow and liquid level applications. Included are features, specifications, and options.

Instant Antifoams

1043

Hodag Chemical Corp., Chicago. Ill., has available a 3-page information sheet and free samples of new Hodag Instant Antifoams. Hodag Instant Antifoams are available in many different formulations to suit specific requirements.

Flow Indicators for Direct Observation

1044

Schutte and Koerting Co., Bucks County, Pa., has just released a bulletin describing the company's line of Flow Indicators for pipeline installation to give positive visual indication of flow conditions.

Dissolved Oxygen Analyzer

1045

Beckman Process Instruments Div., Fullerton, Calif., has available a new four-page bulletin on the Beckman Model 70 Dissolved Oxygen Analyzer.

The Bulletin, a two-color illustrated brochure, gives comprehensive information on the Model 70 which has been designed for continuous, automatic analysis of dissolved oxygen in high purity water.

CONTINUED ON PAGE 140A

switch to Anthrafilt
Trade Mark Reg. U.S. Pat. off.

THE MODERN ALL-PURPOSE FILTERING MEDIUM

Best for All Types of Filters

ANTHRAFILT
offers important advantages over sand and quartz

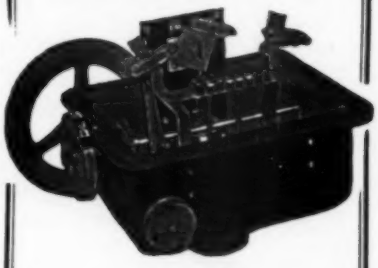
DOUBLES length of filter runs.
REQUIRES only half as much wash water.
KEEPS filters in service over longer periods.
INCREASES filter output with better quality effluent.
GIVES better support to synthetic resins.
PROVIDES better removal of fibrous materials, bacteria, micro-organic matter, taste, order, etc.
IDEAL for industrial acid and alkaline solutions.
EFFECTIVE filtration from entire bed.
LESS coating, caking or balling with mud, lime, iron or manganese.

Write for further information, test samples and quotations to:

PALMER FILTER EQUIPMENT CO.
P. O. Box 1696—822 E. 8th St., Erie, Pa.

Representing
ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Bldg.,
Wilkes-Barre, Pa.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

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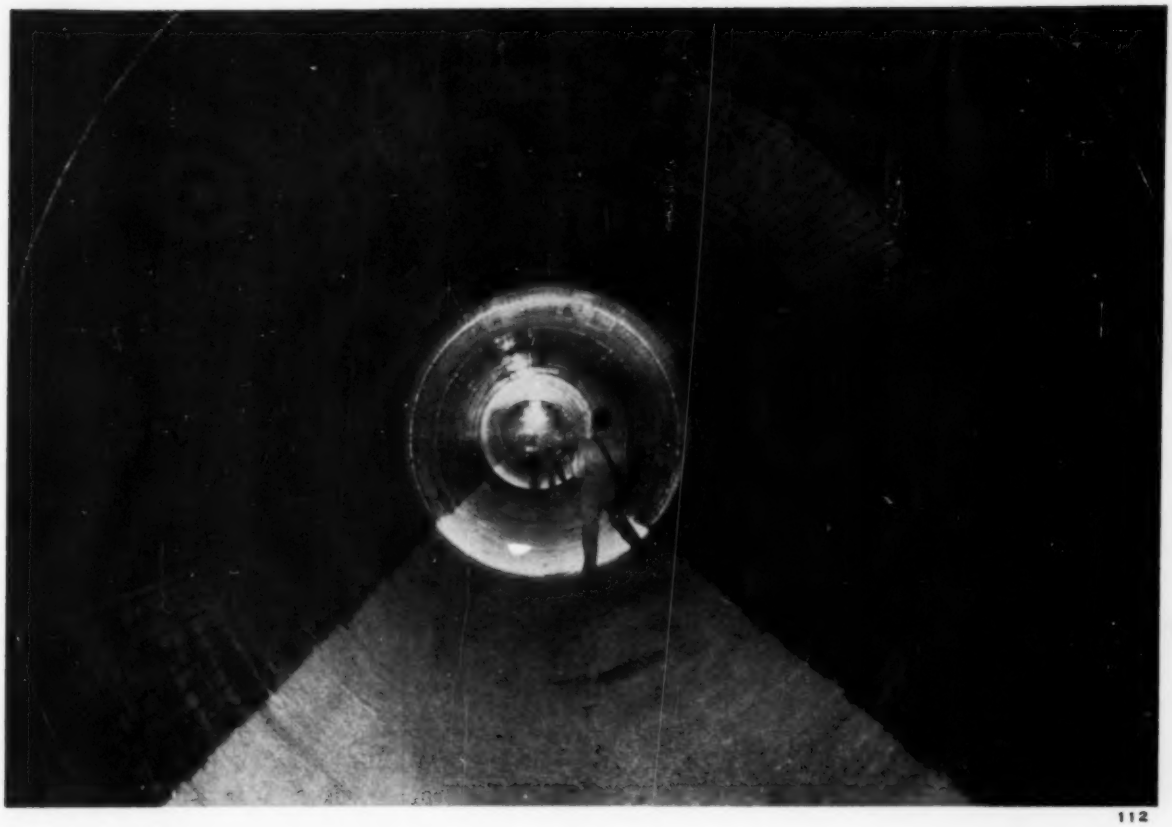

112

This Sewer will go a Long Way

Not only will this 9½-foot outfall sewer extend eight miles, but it will go a long way in years of trouble-free service. The engineers who designed it say that it will still be functioning perfectly in the year 2000.

Their confidence is based on wise choice of construction materials. Every joint of pipe, every foot of monolithic tunnel, every structure is built of reinforced concrete to obtain structural strength at low cost. Every surface above the low flow line is completely covered by a continuous membrane of T-Lock Amer-Plate®, the vinyl lining that is impervious to the corrosive action of oxidized hydrogen sulfide *at any level of concentration.*

The engineers know that no one can accurately predict future rates of H_2S gas generation, so they have insured the ultimate life of the concrete by investing an extra 8 to 10% for T-Lock protection. They predict that this "extra" will spare their city the cost of a replacement sewer in about 20 years, and *save the taxpayers millions of dollars!*

Because of obvious and substantial savings such as this, millions of square feet of T-Lock are now in use in progressive municipalities from coast to coast. These include Los Angeles; Topeka; Wichita; Sioux City; Shreveport; Washington, D.C.; San Diego; Mansfield, Ohio; Huntington, W.Va.; Hutchinson, Kan.; and Orange County, Calif. T-Lock Amer-Plate is also on current specifications for many other municipalities. For complete list of users and specifiers, plus technical data and a typical specification, write:

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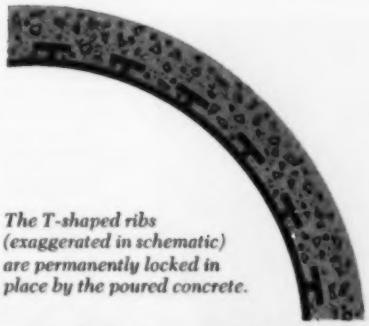
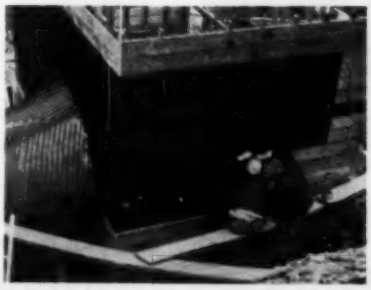
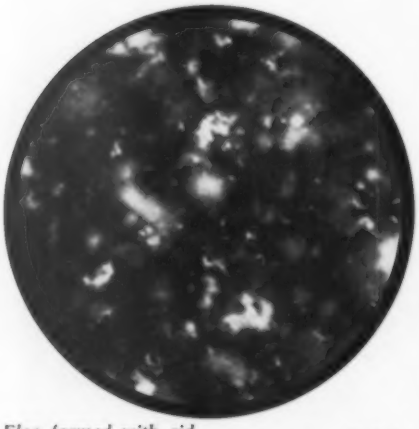


The T-shaped ribs (exaggerated in schematic) are permanently locked in place by the poured concrete.



There is no limitation on size or shape of structures which may be protected with T-Lock Amer-Plate.



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In the valve's most vital part—the valve seat—the stainless steel-edged disc seats tightly against the crowned, abrasion-resistant surface of the multi-ply rubber seat. The entire seat insert is secured to the body by serrated contact with the retainer segments. The entire seat can be conveniently removed and replaced at site of installation.

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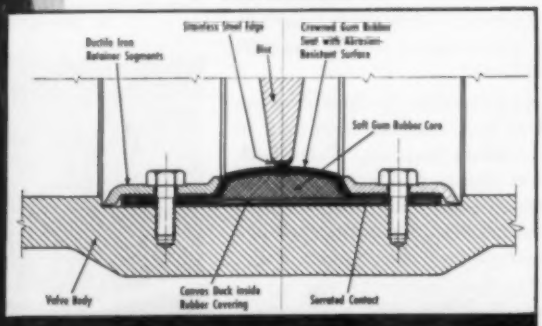

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Bulletins Helpful

CONTINUED FROM PAGE 138A

Automatic Water Control Valves

1046

Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has just published an 8-page bulletin describing nine different automatic water control valves and their uses.

Nomograph For Sizing Chemical Feeding Systems

1047

Milton Roy Co., Philadelphia, Pa., has developed and published a nomograph to assist design engineers determine the ideal capacities for the controlled volume pump and the chemical holding tank.

Selecting Dall Tubes, Venturi Tubes and Nozzles

1048

Builders-Providence, Inc., a div. of B-I-F Industries, Inc., Providence, R. I., has published a technical bulletin that users of Dall Flow Tubes, Venturi Tubes and Venturi Nozzles for the metering of all fluids will find helpful when they are faced with the problems of selecting the proper throat size and calculating the head loss in various applications.

New Concepts in Air Diffusion

1049

Walker Process Equipment, Inc., Aurora, Ill., has just released a new 8-page 2-color bulletin discussing the theory and application of air diffusion, in sewage and waste treatment.

Degritting Clarifier

1050

Dorr Oliver, Inc., Stamford, Conn., has announced the availability of a new four-page, two-color bulletin entitled, "The Degritting Clarifier and Clarigester." Also included are installation photographs and sectional elevation drawings of typical grit handling facilities of this new design.

CONTINUED ON PAGE 142A

NO DOWN TIME YET

WEINMAN sewage pumps installed 20 YEARS AGO

This Weinman pump installation at the Ephrata, Pa., sewage plant is 20 years old. It consists of a bank of 3 Weinman 6UH-VB non-clog pumps. They operate 24 hours a day, 7 days a week—and have since 1938.

Not one of these pumps has lost a minute's down time in all those years, according to officials.

What's more, 3 additional Weinman 4UH-VS pumps installed at the same time at booster stations in Ephrata have delivered *this identical trouble-free performance.*

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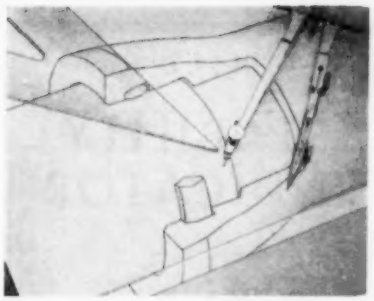

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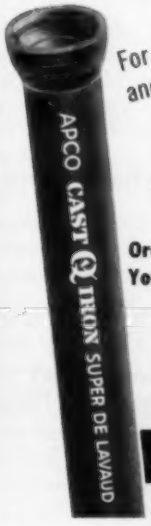

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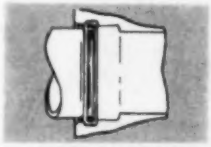
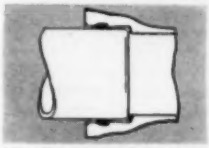
Insert Rubber gasket in bell end of pipe — you can't put it in wrong — A child can do it.

Wipe on a small amount of special lubricant—This reduces friction.



Insert plain beveled end of pipe — there are no grooves, ridges or tips on gasket to interfere with smooth insertion.



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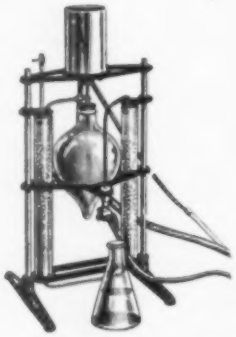

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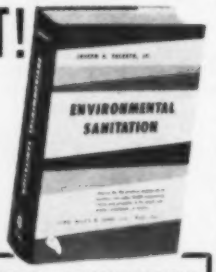

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Helpful Bulletins

CONTINUED FROM PAGE 140A

Pneumatic Transmission Lines 1051

Bailey Meter Co., Cleveland, Ohio, has just published a 4-page product specification describing Armortube Cable, a flexible, armored, multiple tube transmission line for pneumatic and hydraulic metering and control systems.

Sealed Register Water Meter 1052

The Municipal and Utilities Div. of Rockwell Mfg. Co., Pittsburgh, Pa., has just published a new, multi-color, 20-page catalog describing the Rockwell Sealed Register meter.

Primary Flow Metering Elements 1053

Builders-Providence, Inc., a division of B-I-F Industries, Inc., Providence, R. I., has prepared a small, convenient 16-page folder to assist in selecting the proper differential producer for every flow metering situation. The heart of the folder is a table

Ductile Iron Pipe Fittings 1054

Kuhns Brothers Co., Dayton, Ohio, has released a new 8-page illustrated catalog giving complete data on ductile iron pipe fittings.

Valve Actuating Conversion Unit 1055

C. H. Wheeler Mfg. Co., Philadelphia, Pa., has published a four-page two-color catalog describing a new automatic valve actuating conversion unit.

Cylinder Actuators 1056

Conoflow Corp., Philadelphia, Pa., has recently issued a 12-page booklet describing the company's complete line of Series 50 Cylinder Conomotor actuators.

How to Lay Concrete Pressure Pipe 1057

Price Brothers Company, Dayton, Ohio, has just issued a new and revised edition of the manual "Concrete Pressure Pipe Laying Instructions."

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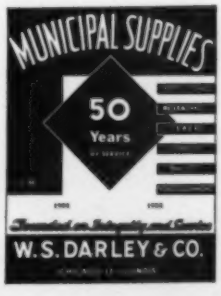

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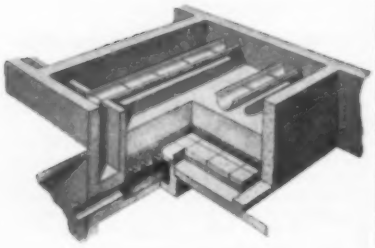


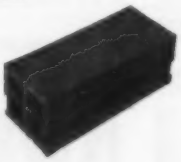
Filter unit showing Leopold Filter Bottom and Leopold Fiberglass-Reinforced Plastic Wash Troughs

Performance Proved in over 375 plants with a daily capacity of more than 2¾ billion gallons!

In this design, laterals and distributing blocks form a permanent unit that assures equal filtration and uniform wash distribution with low loss of head. Made of de-aired fire clay—vitrified and salt glazed—the blocks can't corrode, won't absorb water, are acid and alkali resistant, and are not subject to tuberculation.

In addition, the Leopold Filter Bottom needs only a shallow depth of small-sized filter gravel, does not require supporting concrete structures, and is the only design providing a fixed and controlled secondary backwash.

Literature and Complete Details Furnished on Request!



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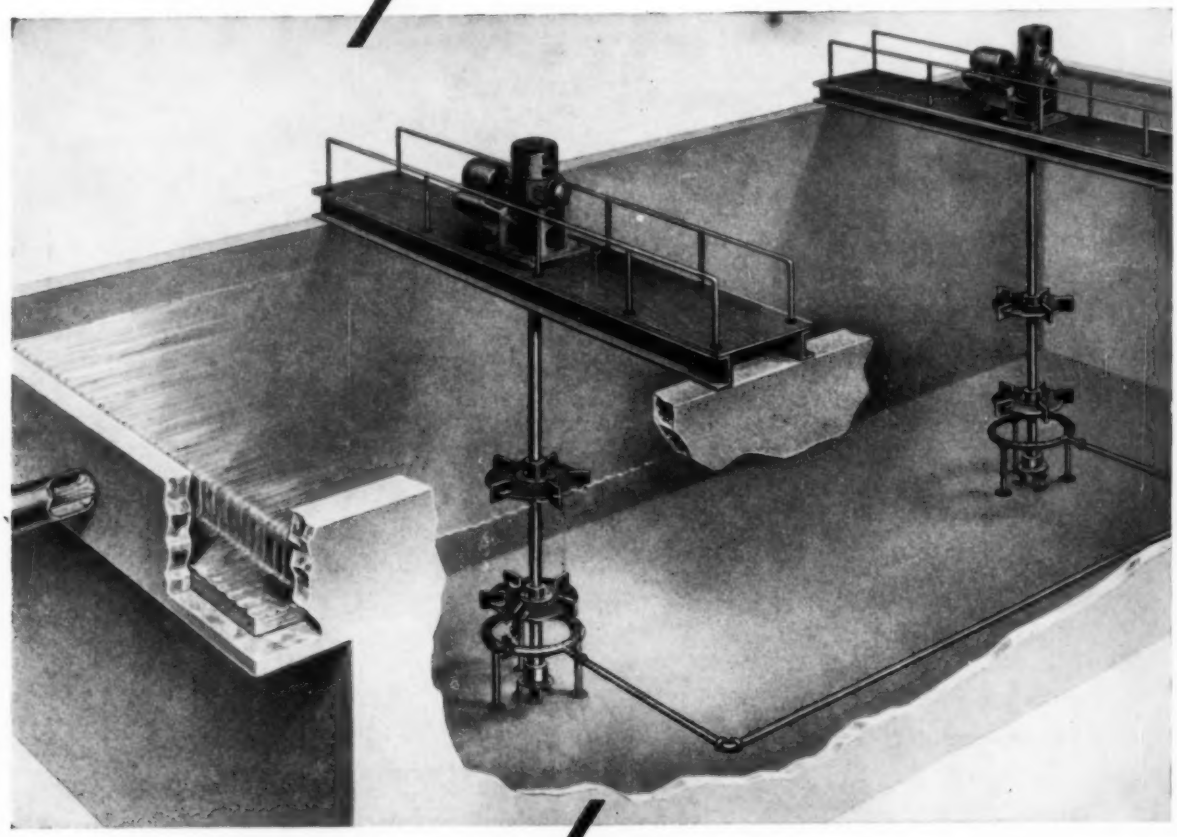

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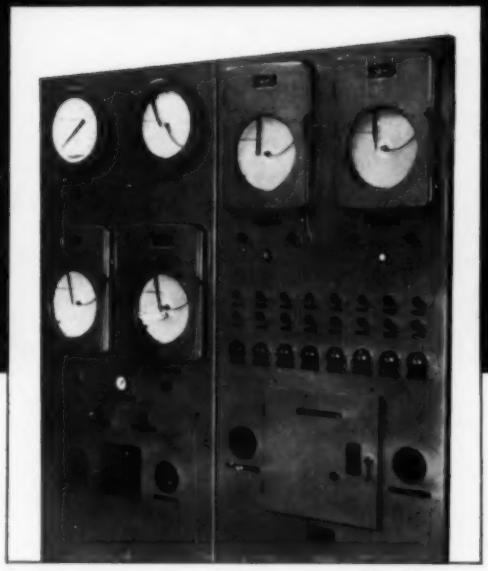

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